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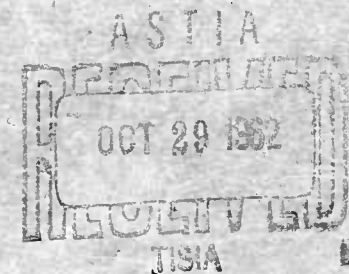
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TECHNICAL AND POLITICAL ASPECTS OF
ARMS CONTROL NEGOTIATION:
THE 1958 EXPERTS' CONFERENCE

Ciro Elliott Zoppo



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PREFACE

This Memorandum is the last of a series on arms-control negotiations, with particular reference to the nuclear test-ban talks. Two previous Memoranda have already been distributed: the author's The Issue of Nuclear Test Cessation at the London Disarmament Conference of 1957: A Study in East-West Negotiations (RM-2821-ARPA), and Nathan Leites' Styles in Negotiation: East and West on Arms Control, 1958-1961 (RM-2838-ARPA).

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SUMMARY

Increased participation by technical experts has characterized the emergent diplomacy of the nuclear age. The technical content of international politics has been particularly enlarged in formal negotiations for arms control. Disarmament negotiations have demonstrated the difficulty of separating technical from political considerations, whether to facilitate policy formulation or to hasten international agreement.

The dependence of the U.S. government on technical and scientific advice has been well illustrated by the negotiations for an agreement on the cessation of nuclear weapon tests. The 1958 Experts' Conference, though not the most politicized of the technical talks so far held, demonstrates clearly the interaction of political and technical factors. Their separation in practice has become virtually impossible because of the incompatibility of Communist and Western approaches to technical discussion. The record of the conference also shows how the politicizing of technical-scientific discussions on arms control has forced the scientific expert into the role of negotiator.

Verification of compliance has been the touchstone of the U.S. position on the arms-control problem and has been central in the relationship between the technical and political aspects of disarmament negotiations. The problem of agreeing on an effective control system with international inspection was a central theme of the 1958 experts' talks at Geneva. The conflict between Soviet and Western

negotiatory objectives aggravated the difficulties flowing from the fact that existing technology could not ensure effective verification.

The American delegation believed the purpose of the discussion to be a scientific investigation of the capabilities of technology to furnish adequate means to monitor a test ban. Agreement to ban tests was to be decided by the governments. The Russians, though conceding that this prerogative was outside the scope of the Experts' Conference, chose to treat the technical talks, whatever their outcome was to be, as a positive step toward universal test cessation either by a test moratorium or an agreement. The substance of the discussions was of secondary importance.

The West tried to separate technical and political questions and sought to build political agreement on a prior scientific consensus. While Westerners were aware that technical requirements often have political implications, their approach stemmed from a conviction that technical facts have a truth of their own that is readily acceptable by any rational person. Moreover, they then regarded technical agreement as a step toward an agreed basis for negotiations at the political level.

Communist ideology, on the other hand, made the Russians see all issues as essentially political. They even attempted to argue with demonstrable facts where politics seemed to require it.

The American propensity to view expert discussion in a predominantly technical perspective was strengthened by the generality of Western negotiatory goals. The

Administration had a limited view of how much political guidance the American scientists might need. Political advisers were sent to Geneva, but they played a secondary role. The aim was to avoid political issues in order to insure a smooth and logical progress from mutually acceptable data to agreed technical conclusions. U. S. experts were told to look upon their job as a purely technical-scientific one. They were alerted, however, to the danger that a test-ban treaty might be deliberately evaded, a political problem at the heart of the long-standing U. S. position that effective control must form the basis of agreement.

In general, the Eastern scientists tended to be theoretical and optimistic about verification, while the Westerners were empirical and cautious. The Americans tried to face up to the difficulties of treaty evasion, the Russians to avoid them.

The Soviet Union had been trying to get the U. S. and Britain to stop nuclear testing ever since the 1957 London disarmament conference. Its optimism in 1958 about the possibility of detecting and verifying violations was a natural accompaniment of Moscow's desire to rush the Western powers into a hasty test-cessation.

Although the conclusions reached by the conference were, on the basis of then available information, technically correct, not all decisions taken by the scientists can be justified on technical grounds. Technical and scientific arguments predominated, but their acceptance often depended more on political than on technical considerations.

Disagreement on vital points was often settled by reaching some form of accommodation outside the plenary sessions of the conference. When concurrence was not forthcoming at full sessions, the informal committee meeting became the tool by which agreement was reached. The large part played by ad hoc committees in reaching conclusions on the various methods of detection, and in the drafting of the final report, indicates the basically negotiatory nature of the Experts' Conference. The members of the committees were delegated by the mission heads to discuss specified problems. The fact that no formal records were kept for publication by both sides undoubtedly facilitated agreement.

U.S. scientists arrived at Geneva with inadequate experimental data. More serious, however, was the vaguely defined political position of the West, particularly in relation to the criteria for assessing the adequacy of verification procedures. The basically negotiatory nature of the conference, coupled with inadequate political guidance, put the West at a disadvantage. The American scientists were forced to negotiate on questions they had not anticipated, and on some points to formulate policy ad hoc. Though experimental information was lacking, the main problem was not agreeing on the technical facts, but using them as a basis for political decisions that were outside the conference's terms of reference but had to be made if the conference was to achieve its purpose. For example, the determination from the viewpoint of national security of the adequacy of a verification system that is admitted to have a given degree of technical reliability is essentially a political not a technical question.

The exact changes in the American position are difficult to determine from the available record. Nevertheless, had the U.S. policy-makers fully understood how intimate is the relationship of political and technical factors in joint technical discussions between representatives of rival states, and how difficult it is to exclude the negotiatory process from such talks, they might have given more extensive guidance to the Western experts. Had they done so, the Western scientists would doubtless have been more conscious of their role as negotiators. If, in addition, the technical aspects of verification systems had been thoroughly studied in advance, and if a consensus had been obtained among the American experts concerning the risks involved in accepting various levels of verification capability, then the Experts' Conference might have bequeathed to the subsequent U.S. position at Geneva a more solid base for the defense of on-site inspection. In a word, the politically acceptable parameters for several hypothetical systems of verification should have been defined for the Western experts before the conference met.

If the continuous relationship between growing technical knowledge and developing policy is fully studied and mutually understood by Western policy-makers and technical experts before we undertake to confer with the Communists, then Western scientists will be better able to respond to their Soviet counterparts when the latter inject political factors into technical discussions. Such an understanding might improve the prospect that U.S. policies would not be attenuated in the process of negotiation.

The conclusions reached here from the Western experience at the 1958 technical conference are borne out by events at later technical as well as political talks looking to a nuclear test ban, and by the Geneva Surprise Attack Conference. In considering negotiatory policy, it is unrealistic to expect that political and technical questions can be kept separate. It is therefore probably unwise to hope, as some have hoped in the past, that joint technical discussions can be used to smooth the way to political agreement.

If Western experts cannot avoid negotiating in collating their technical findings with those of the Communists, then progress toward arms control may be more rapid if technical agreement is achieved through a frankly negotiatory approach and candid bargaining on the basis of clearly defined positions. Perhaps, conversely, technical and scientific factors should be discussed freely by diplomats in political negotiations, with continuous advice from technical experts of equal rank who are present at the negotiations.

The method by which the final report of the Experts' Conference was achieved -- the delegation of circumscribed problems to select committees -- also supports the idea that a deliberately negotiatory approach would be useful in technical as it obviously is in political talks. It may be objected that outright formal bargaining is not conducive to independent thought on the part of experts, and that it would vitiate the scientific content of a technical consensus. Yet we can hardly avoid the admission that postwar technical conferences on arms control between the Communist and Western powers have not been purely

scientific meetings. The comparison of data has not always led to similar conclusions by the scientists of the two sides. The presentation of available facts in a technical forum has led to conclusions influenced by political imperatives. Since decisions taken in political negotiations must be based on policy considerations much broader than purely scientific ones, it might help to integrate the technical and political aspects, and to consider the quest for formal arms control agreements as an essentially political or negotiatory activity.

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I. INTRODUCTION

While the development of nuclear weapons and delivery systems has led both the East and the West to recognize that a more or less precarious and unbalanced state of mutual strategic deterrence exists, the attainment of even a limited reduction of the threat of nuclear war through negotiated agreements for arms control has so far been frustrated. As long as the world faces this threat, negotiations, no matter how sporadic and inconclusive, are likely to persist.

In the postwar arms-control efforts, the conference for an agreement to cease nuclear testing, and the related four technical conferences, have produced the most substantial negotiations.¹ These negotiations have illustrated, better than any other contemporary effort in the field, the complex political, military, and technical problems raised by even partial measures of arms control once they leave the realm of mere propaganda. They have highlighted the

¹The political conference convened on October 31, 1958, and was recessed, sine die, on January 29, 1962, after 353 meetings. Discussions have continued in a subcommittee of the Conference of the Eighteen-Nation Committee on Disarmament, which has been meeting in Geneva since March 21, 1962. Of the technical conferences, one, the Experts' Conference, preceded the plenary conference and met from July 1 to August 21, 1958; three convened in 1959; and one in 1960. The second of these conferences met from June 22 until July 10 and dealt with high altitude detection. The third, called Technical Working Group II, sat from November 25 to December 18 and discussed underground detection. Another, in 1959, discussed staffing. The expert talks that took place from May 11 to May 27, 1960, discussed ways and means by which a coordinated seismic research program could be carried out by the U.S., the U.K., and the U.S.S.R.

potential conflict between the military and the political goals of national policy, and have made explicit the functional interdependence between the technical and diplomatic phases of negotiations.

The interlacing of political and technical questions was one of the salient characteristics of the Geneva test ban negotiations, and it occurred in both the political and technical conferences. Political desiderata constantly appeared in technical discussion, albeit often indirectly. Technical considerations were not uniformly relegated to discussion by the experts; they also appeared in the bargaining of the political conference.

The process of balancing conflicting political and technical requirements through bargaining has added a dimension to the negotiation of arms control not generally present in diplomatic negotiations, except perhaps in those dealing with economic issues. But the difficulties inherent in this process did not stem, in the test ban conferences, solely from the complexities of arms control. They reflected a fundamental difference of approach to disarmament between the Soviet Union and the West, as represented by the United States and the United Kingdom.

Whereas the imperatives of Soviet policy demanded that scientific facts be forced into an integrated political mold, the West tried to separate technical and political questions and sought to build political agreement on a prior scientific consensus. While Westerners, as a whole, were aware that technical requirements often have political implications, their approach stemmed from a conviction that technical facts have a truth of their own that is readily acceptable by any rational person. Moreover, at that

time they regarded technical agreement as a step toward an agreed basis for negotiations at the political level. It is not surprising, therefore, that the history of postwar disarmament negotiations abounds in Western proposals for joint preliminary studies, by the experts of both sides, designed to explore problems of technical feasibility as a prelude to agreement.²

²The proposal to convene a technical conference to study the possibility of detecting nuclear explosions was one of a long series starting immediately after World War II. For examples, see: U.S. Department of State, Treaties and Other International Acts, Joint Declaration by the Heads of Government of the United States, the United Kingdom, and Canada (Nov. 15, 1945), Par. 8, Series 1504, 60 Stat. 1479; UN Disarmament Commission, Official Records: Supplement for January to December 1956, United States Working Paper Submitted to the Disarmament Subcommittee: Technical Exchange Mission (March 21, 1956), DC/SC.1/39; UN, Fourth Report of the Sub-Committee of the Disarmament Commission, Western Statement in the Disarmament Subcommittee on Nuclear Test Suspension (July 2, 1957), DC/SC.1.59; Department of State Bulletin, Letter from President Eisenhower to Soviet Premier Bulganin, January 12, 1958 (Jan. 27, 1958), pp. 122-127, Part IV; Ibid., Note from the American Embassy to the Soviet Foreign Ministry: Prevention of Surprise Attack (July 31, 1958), pp. 278-279; UN General Assembly, British Draft Resolution Introduced in the First Committee of the General Assembly, A/C.1/L.251 (Oct. 14, 1960); U.S. Arms Control and Disarmament Agency, President Kennedy's Letter of March 7, 1962 to Nikita S. Khrushchev, and Statement by the Secretary of State at the Conference of the Eighteen-Nation Disarmament Committee (March 15, 1962). Another attempt, by Britain, to set up a body of experts to study the problems posed by the need for adequate verification of the elimination and destruction of nuclear weapons, was rebuffed by the Soviet Union in Geneva on June 7, 1962. It should be noted, in this context, that the Western tendency to try to separate technical and political aspects and to allow policy to emerge from the technical analysis is not completely novel. Woodrow Wilson's handling of the American delegation at the Paris Peace Conference and his use of the Commission of Experts there are another example.

Communist ideology, on the other hand, makes the Russians see all issues as essentially political.³ Political considerations seem to be uppermost in the minds of Soviet negotiators even in technical discussion, and they may attempt to deny demonstrable facts where politics seems to require it.⁴

It must be admitted, however, that in the context of arms control few technical problems are politically neutral. They have political implications and may be influenced by policy preferences, political expectations, and value judgments. It is usually difficult, therefore, to resolve a negotiatory impasse at the political level solely by resorting to technical discussion. Though seemingly not the U.S. view in 1958, the general purpose of negotiation is to obtain a political settlement not an agreement among technical experts. Nevertheless, arms control does involve certain technical requirements that may not be circumvented for the sake of political accommodation without compromising the ultimate ostensible goal of the negotiations. For example, though the exact requirements for effective verification of compliance with an agreement

³For some illustrations of this point, see Conference on the Discontinuance of Nuclear Weapons Tests, Verbatim Records, No. 38, pp. 32-33; No. 41, p. 6; No. 152, p. 18; No. 154, p. 6; No. 188, p. 11; No. 289, pp. 13-15; No. 315, pp. 23-26.

⁴Conference of Experts to Study the Methods of Detecting Violations of a Possible Agreement on the Suspension of Nuclear Tests, Verbatim Record No. 6, July 8, 1958, p. 47, and No. 24, August 1, 1958, pp. 21-26. (Hereafter these records are cited as Verbatims. All dates refer to 1958.)

can be problematic and open to debate, there are unquestionably certain technical boundaries within which a political compromise on this aspect of arms control must take place.

The U.S. has viewed the verification of compliance as the touchstone of the arms control problem and it has been central in the relationship between the technical and political aspects of disarmament negotiations. The problem of agreeing on an effective control system with international inspection was a central theme of the Geneva talks in 1958. The political requirement that compliance be adequately monitored inevitably created technical requirements. Some of these, such as a global control network, would have created political problems of the first magnitude, especially with regard to aspiring nuclear powers like France and Communist China, had agreement been reached. Their accession to the treaty was to have become mandatory in the second phase of the control network's installation.⁵

The conflict that became apparent between Soviet and Western objectives in the actual conduct of negotiations aggravated the political difficulties flowing from the fact that existing technology could but inadequately meet the requirements of effective verification. It does not necessarily follow that the problem of effective verification could have been resolved simply by a change in Soviet

⁵For discussion of this see the writer's The Accession of Other Nations to the Nuclear Test Ban, The RAND Corporation, RM-2730-ARPA, March 1961.

disarmament policy. The monitoring of arms control measures generally involves complex but crucial political questions that are just as much a function of the present nation-state system of international politics as of the East-West struggle, though made uniquely difficult by the ideological aims of Soviet foreign policy. To put it another way, arms control involves the vital interests of nations, and must be negotiated by actual or potential enemies if it is to be effective.

Examination of the test-ban negotiations discloses how closely related are technical and political factors, and suggests that it is unrealistic to keep them wholly separate when considering policy. Judgments about the adequacy either of a particular measure or a system of verification, depend crucially on the assessment of the political factors. A purely technical approach to the organization of verification may reduce certain political problems but will not eliminate them altogether. Furthermore, arms control questions generally involve considerations beyond the province of the physical scientist. These include strategic problems whose solution depends on judgment and not exclusively on calculation, for example the net effect of a given arms control measure upon national security. There remains in addition the problem of determining the political relevance of the scientific data that form the basis of expert consensus.

James B. Fisk, who led two U.S. delegations to technical conferences concerned with a test ban (the Experts' Conference and Technical Working Group II), has noted that "although the technical content of arms control

negotiations is likely to be very high...experience in the nuclear test and surprise attack negotiations has shown that technical and political arguments cannot be separated completely and for long.... The Soviets recognized this interplay from the beginning."⁶

This study analyzes the interrelation of political and technical factors that arose during the discussions of the 1958 Experts' Conference. The conference met to investigate the possibility of detecting violations of a possible agreement on the suspension of nuclear tests, and formed the basis for the subsequent political conference in Geneva.

A concentration of attention on the Experts' Conference is desirable because the 1958 talks dealt with the verification problem as a whole, and discussed most relevant technical aspects. The other technical conferences about a nuclear test

⁶U.S. Senate, Strengthening the Government for Arms Control, Document No. 123, 86th Cong. 2nd Sess., 1960, p. 7. A somewhat different but complementary approach is taken by the chairman of the Senate's Disarmament Subcommittee, Hubert Humphrey, who has stated that "the political aspects of disarmament are to be almost wholly conditioned on the knowledge the negotiators have of the technical feasibility of disarmament." U.S. Senate, Subcommittee of the Committee on Foreign Relations, Hearing on Disarmament Developments, Spring 1960, 86th Cong., 2d Sess., June 10, 1960, p. 22. After his experience as head of the Western delegation to the Surprise Attack Conference, William C. Foster also noted the difficulty of separating the technical from the political in analyzing arms control problems, and in pursuing technical discussion. U.S. Senate, Foreign Relations Subcommittee on Disarmament, Hearings on Disarmament and Foreign Policy, 86th Cong., 1st Sess., January 30, 1959, p. 61.

ban had a much narrower scope of discussion. The Experts' Conference, being the first and the most productive of agreement, has been studied little in terms of its negotiatory characteristics. Yet its value lies precisely in its comparative freedom from acrimonious political debate. Moreover qualified agreement was reached on important technological conclusions, and this is more than can be said of Technical Working Group II, or the Surprise Attack Conference. These characteristics of the Experts' Conference offer an opportunity to investigate the negotiatory process in technical discussion between antagonists. The talks illustrate how even fruitful technical consultation between political opponents can become politicized to a point where a basic technical consensus may be difficult to achieve.

An attempt is made to identify the process and the means by which agreement was reached between the opposing sides in this technical negotiation on arms control. To clarify the role of technical discussion in arms control negotiation between the Soviet Union and the West, the paper also discusses the possible effect of various political considerations on scientific argument and draws attention to the political implications of the technical requirements under discussion.

The main evidence for the conclusions comes from the 1958 Experts' Conference. This is supplemented, on occasion, with material from the subsequent political conference at Geneva and other relevant technical meetings, like Technical Working Group II and the Conference on the Detection and Identification of High-Altitude Nuclear Explosions.

In this analysis, a "political question" is one which concerns the objectives of policy relating to other than purely technical matters. Many technical questions discussed at Geneva had more or less obvious political implications. Others could be discussed without arousing tacit or explicit concern over their effects on the pursuit of policy. Sometimes the separation of political and technical factors was achieved only in an analytical sense. The term "political" by itself, will connote various shades of meaning depending on the context. Finally, when technical and scientific material is quoted, it is introduced mainly to show the difference of approach between the scientists of the two sides. No pretense is made to discuss the scientific validity of the data or theories contained in the quotations.

II. THE SETTING OF THE EXPERTS' CONFERENCE

The increasing tempo of nuclear testing was one of the more dramatic symptoms of a full-fledged nuclear arms race that emerged after 1954 and spurred the search for security through arms control. Two other developments also focussed public attention in the Western countries on the need, as well as the possibilities, for arms control measures. The first, Soviet advances in military technology (crowned in 1957 by the launching of an ICBM in August and the Sputnik space shot in October), led many to question the assumption of American military superiority and emphasized the potential vulnerability of the United States to Soviet strategic attack. On the other hand, the second development, Khrushchev's "peaceful co-existence" policy, which was made more credible by the signing of the Austrian State Treaty in May 1955 and by growing cultural contacts between the blocs, encouraged hopes for a détente.

Moreover, influential segments of the American and British public increasingly favored a nuclear test ban as (1) a way to slow down further nuclear weapons development, and thereby slow down the arms race, (2) a means of curbing the diffusion of these weapons to new countries, and (3) an important first step toward more comprehensive disarmament measures. Some Americans also believed, because of the U.S. lead in nuclear

weapons development, that a test ban might leave the United States in a position of some technological superiority.⁷

By 1958 these developments had generated considerable domestic political pressures on the British and American governments. Countries opposed to testing, led by India and Japan, took action at the UN. These trends increased Western receptiveness to Soviet propaganda and negotiatory maneuvers designed to bring about negotiation on test cessation. The Government of the United Kingdom and the U.S. Administration began to move in the direction of separate negotiations for a test-ban treaty. This was the main Soviet objective at the 1957 London Disarmament Conference, where the Western position supporting integrated arms-control discussions was gradually whittled away.⁸

After the London talks adjourned in September 1957, the West modified its opposition to separate test-ban negotiations, but with great reluctance and ambiguity. During a news conference on July 10, 1958, Secretary Dulles described the transition from a policy of "package" disarmament talks to one of separate test-ban talks as a change

⁷ See, for example, the National Planning Association's 1970 Without Arms Control, Planning Pamphlet 104 (May 1958), and Establishing International Control of Nuclear Explosions, Special Report No. 50 (July 21, 1958), the testimony of Dr. Hans Bethe before the Humphrey Subcommittee February 2, 1959, p. 179, and of Mr. Foster in the hearings on the review of operations of ACDA, March 8, 1962, pp. 59-60.

⁸ For a detailed investigation of negotiation on test cessation during the London talks, see C. E. Zoppo, The Issue of Nuclear Test Cessation at the London Disarmament Conference of 1957: A Study in East-West Negotiations, The RAND Corporation, RM-2821-ARPA, September 1961.

from insistence on "conditions precedent" to acceptance of "conditions subsequent." He went on to say that

in the package proposal...put up in London [the other measures] were tied together in the sense that they were all to get started at the same time and all be agreed upon at the same time. The separation that is under consideration is in terms of not necessarily insisting that they should all be agreed to and get started at the same time, but that we would start perhaps at different times....⁹

The preceding week, in his testimony before the Senate Committee on Foreign Relations, the Secretary had said:

Now a great deal of thought has been given to changing that position, [i.e., the package proposal] and we have had exchanges of views with our allies.... So far, there has been no decision made to change it, but I would say that the question of whether it will be changed is very much an open question at the present time.¹⁰

While the American insistence on a package deal was fading, there was no slackening of the Western demand that technical discussion and agreement precede political

⁹New York Times, June 11, 1958. The U.S. did not formally drop its insistence that duration of the test ban treaty be made contingent in part on progress in disarmament until January 19, 1959.

¹⁰U.S. Senate, Review of Foreign Policy, 1958: Hearings Before the Committee on Foreign Relations, 85th Cong., 2d Sess., Part 4, p. 810.

negotiation.¹¹ Verification of treaty fulfillment, the keystone in any structure for arms control, was in the first instance a technical matter. Politically, however, the inspection problem has been the most intractable one encountered in postwar disarmament talks.

The Soviet acceptance, in principle, of the concept of control with inspection, in 1954, has time and again led Western statesmen to believe that agreement on some measure of arms control might be possible. Time and again this hope has been wrecked by Soviet objections and unacceptable counterproposals that undermined the basis for effective inspection. Soviet negotiation techniques grounded in ambiguity and outright evasion of substantive discussion have also thwarted progress.

The concept of joint technical discussions was alien to the Soviet approach at the 1957 London disarmament talks. The Soviet delegate then showed concern only for the political aspects of test cessation. When the Soviet Union later consented to participate in technical talks, it exploited them as a means to further Soviet foreign policy objectives.

On May 9, 1958, President Eisenhower suggested that, as a means of "moving toward ultimate agreement,...technical

¹¹See, for example, the remarks by Mr. Lloyd in the House of Commons, November 8, 1957, in U.K., Parliamentary Debates (Hansard), House of Commons Fifth Series, Vol. 577, cols. 475-479, and Part IV of the letter from President Eisenhower to Soviet Premier Bulganin of January 12, 1958, Department of State Bulletin, January 27, 1958, pp. 122-127.

people work immediately upon the practical problems...of supervision and control..., to agree on what would be required" to verify nuclear test cessation.¹² Khrushchev stated in reply:

The problems of control of the cessation of atomic and hydrogen weapons tests in no way represent an obstacle to an immediate cessation of such tests.... Your messages indicate that you attach great importance to having experts study the details connected with the control of the execution of an agreement on the cessation of...tests. Taking this into account, we are prepared, in spite of the serious doubts on our part,...to try even this course. [Emphasis supplied.]¹³

As will be seen later, serious doubts about the purpose to be served by technical consultation are a recurring characteristic of the Soviet approach to arms control negotiation. In 1957 the Soviet Union may have suspected that expert discussion would be used by the Western powers to stall or sidetrack debate on test suspension. But after the collapse of the London conference, when test cessation became a separate issue, Western insistence on the need for expert consultation probably convinced the Kremlin that a joint technical committee to investigate ways to enforce control was part of the price it would have to pay

¹²Department of State Bulletin, May 19, 1958, pp. 811-812.

¹³Ibid., June 9, 1958, pp. 940-942.

for American agreement to enter separate negotiations for a test-ban treaty. On March 31, the Soviet Union had already undertaken a major maneuver to bring about such negotiations when it unilaterally suspended nuclear testing.¹⁴

On July 1, 1958, a "Conference of Experts to Study the Possibility of Detecting Violations of a Possible Agreement on the Suspension of Nuclear Tests" met at Geneva, Switzerland.¹⁵ The Experts' Conference considered the major technical provisions required to monitor a test ban. These were never entirely submerged by political factors even during the negotiations at the political conference. In fact, the relationship between the political and technical aspects of subsequent negotiations in Geneva cannot be properly understood without reference to what occurred at the technical talks. Beginning with the Experts' Conference, technical factors played a significant role in the political negotiations as well as in the formulation of U.S. policy.¹⁶

¹⁴The decree approved by the Supreme Soviet of the USSR not only stipulated that the Soviet Union would discontinue nuclear weapons tests, but also added that if "other Powers possessing atomic and hydrogen weapons continue tests...the Government of the USSR will naturally be free to act in the matter of the carrying out of atomic and hydrogen weapons tests...." UN Doc. A/3820, April 8, 1958.

¹⁵New York Times, July 2, 1958.

¹⁶The remarks of Secretary Rusk on March 23, 1962, to the UN Disarmament Conference suggest how deeply American policy was affected. New York Times, March 24, 1962.

By August 21, 1958, the Conference had agreed on a final report, which it made public on August 30.¹⁷ Had scientific consensus bridged the gap between the original Western and Soviet positions? An analysis of the debate between the scientists of East and West at Geneva must be undertaken before this question can be answered. Such a task invites other questions of particular relevance to arms control negotiation. Some of these, such as the difference between the Soviet and the Western approach to expert discussion especially in relation to objectives, the negotiatory mechanism through which scientific consensus is reached, and the extent to which political preferences govern scientific argumentation even in matters of demonstrable fact, may yield lessons applicable beyond the case of the test ban.

¹⁷For text see Department of State Bulletin, September 22, 1958, p. 453.

III. OBJECTIVES AND NEGOTIATORY BEHAVIOR

One of the dominant features of the Geneva negotiations for a nuclear test ban agreement was the contrast and conflict between the Soviet view of arms control as essentially a question of political arrangements and the Western view, firmly grounded in pragmatic consideration of the technical capabilities and shortcomings of verification. This contrast explains in large measure the divergence of real negotiatory goals which underlay the apparent harmony of the formal terms of reference of the delegations to the Experts' Conference.

The American delegation wanted the purpose of the discussion to be a scientific investigation of the capabilities of technology to furnish adequate means to monitor a test ban. Agreement to ban tests was to be decided by the governments. The Russians, though conceding that this prerogative was outside the scope of the experts' conference, chose to treat the technical talks, whatever their outcome was to be, as a positive step toward universal test cessation either by a test moratorium or an agreement. The talks were a kind of ritual to be performed before what they desired could come to pass. The substance of the discussions was of secondary importance.

There was an understanding between the Soviet Union and the United States that the experts would meet for a period of thirty to sixty days and study the possibility of detecting violations of a possible agreement to suspended nuclear tests. Perusal of the preliminary Soviet-American exchanges

that led to the agreement to convene the Conference, however, reveals a serious divergence of views about the purposes the meeting was to serve.¹⁸

In his first specific allusion to the American proposal that Soviet and American technicians meet and agree on advice about specific control measures, Khrushchev doubted the usefulness of such a procedure. "Is it possible," he asked, "for technical experts to contribute anything to the solution of the problem of disarmament if no agreement between Governments has been reached at this point?"¹⁹ In other words, a political agreement to stop nuclear tests should be reached before initiating technical studies. This was consistent with the Soviet position at London in 1957. When technical discussion prior to political negotiation was accepted by Moscow, it was "with serious doubts," and with the hope that this concession to American desires would hasten the end of

¹⁸Department of State Bulletin, "Letter from President Eisenhower to the Soviet Premier," May 19, 1958, pp. 811-812; Ibid., "Letter from the Soviet Premier to President Eisenhower," June 9, 1958, pp. 940-942; Ibid., "Letter from President Eisenhower to Soviet Premier Khrushchev," June 9, 1958, p. 939; Ibid., "Letter from Premier Khrushchev to the President," June 30, 1958, pp. 1083-1084; White House Press Release, "Letter from President Eisenhower to the Soviet Premier," June 10, 1958; and Department of State Bulletin, "Aide-Mémoire from the American Embassy to the Soviet Foreign Ministry: Geneva Experts' Conference on Nuclear Tests," July 21, 1958, p. 101.

¹⁹Department of State Bulletin, "Letter from the Soviet Premier to President Eisenhower," May 19, 1958, pp. 812-815.

testing. Soviet anxiety to press forward to the main goal of test cessation, whatever the technical feasibility of controls, was made manifest in the wording of their agreement to have "both sides designate experts" who would "immediately begin a study of methods for detecting possible violations...with a view to having this work completed at the earliest possible date, to be determined in advance"²⁰ [emphasis supplied]. Having made the concession, the Soviet Union wanted a guarantee that the technical discussion would not slow up the political negotiations unduly.

More far-reaching was the Soviet expectation that the successful conclusion of the experts' discussions would bind the participating countries to cease nuclear tests. Most communications from the Kremlin immediately before the talks started stressed this point. The Soviet aide-mémoire to the American Embassy in Moscow on June 25, 1958, made it emphatically clear:

The conference will bring benefit only... if it leads to positive results. But how can these positive results be determined, if not [by] the fact that during the course of the work of the experts will be insured achievement of the final goal -- universal immediate termination of experimental explosions of atomic and hydrogen bombs?... If the results of the work of the experts do not lead to the achievement of this final objective, then all their work will be...a fruitless waste of time.... The necessity to terminate nuclear tests was...the basis of the agreement for the

²⁰ Ibid., June 9, 1958, pp. 940-942.

conference and this agreement was fixed in the corresponding documents which were exchanged.... From the beginning the discussion was not in general about a meeting of experts but about a meeting with the indicated concrete goal. [Emphasis supplied.]²¹

The American Government rejected the suggestion of any such relationship between the experts talks and a political agreement to cease nuclear testing. On June 17, during a news conference, Secretary Dulles stated explicitly that "it was agreed from the beginning that this study by the experts would be conducted without prejudice to the question of whether or not there would be a suspension of testing."²² His position was reiterated in official communications to the Soviet Union before July 1.²³ The Administration foresaw, however, that if an understanding were reached by the experts at Geneva, it would facilitate an agreement to suspend testing.²⁴ Differences arising from the differing views about the purpose of the experts' talks remained unresolved as the

²¹Ibid., July 14, 1958, pp. 47, 48. See also July 7, 1958, pp. 11-12; July 21, 1958, pp. 102-103.

²²Ibid., July 7, 1958, pp. 9-10.

²³Ibid., July 7, 1958, p. 11; July 14, p. 47; and July 21, p. 101.

²⁴Department of State, Press Release No. 319, June 10, 1958.

conference opened. The first statements by Fisk and Fedorov illustrate this.²⁵

Fisk stressed: "It is most important to have a common understanding of the technical problems which are involved in this question as a basis for further consideration by our Governments of the important issues on which future decisions will be required [emphasis supplied]."²⁶

Fedorov's emphasis was different: "We are going to consider...the various methods of detecting nuclear explosions with the objective of developing an appropriate system of control for ensuring the implementation of an agreement on the general cessation of nuclear weapons tests. It is not for us, of course, to decide the question of the cessation of tests.... In meeting the wishes of the Western Powers, the experts of our side are prepared

²⁵Dr. James B. Fisk, Vice President of Bell Telephone Laboratories and Member of the President's Science Advisory Committee, and Prof. E. K. Fedorov, Corresponding Member of the Academy of Sciences of the USSR, headed the Western and Communist delegations respectively. Other delegates were: F. Behounek, K. E. Gubkin, H. Hulubei, L. Iurkevitch, O. I. Leipunski, M. Mensovitch, I. P. Pasechnik, M. A. Sadovski, N. N. Semenov, Ch. Simane, I. E. Tamm, S. K. Tsarapkin, and A. Zatopek for the East; and R. F. Bacher, Sir John Cockroft, E. O. Lawrence, Sir William Penney, Yves Rocard, and Omond Solandt for the West. Other experts assisted when special problems arose, among them the Russians Balashov, Brekhoskikh, Kirdin, and Riznichenko; the Americans Bethe, Brown, Latter, Machta, Mark, Northrup, Oliver, Press, Romney, Russell, Turkewitch and Willmore; the Englishmen Bullard and Carroll; and the Frenchman Rothe. Tsarapkin, who later, at the political conference, became chief of the Soviet delegation, was the only non-scientist to sit as a regular delegate at the Experts' Conference.

²⁶Verbatims, July 1, p. 6.

to participate in the discussions on a system of control, in their belief that these discussions should contribute to the cessation of nuclear test explosions on the part of the Western Powers as well." [Emphasis supplied.]²⁷

While the Communists and the West disagreed on the purpose to be served by the joint technical discussions, the dynamics of the negotiations that ensued modified the expectations of both sides concerning the outcome of the conference, and perhaps even their beliefs about the role of technical discussion in general.

A. THE WEST: A TECHNICAL PERSPECTIVE

Western negotiators are committed by education and temperament to negotiate from technically justifiable positions. They are predisposed, therefore, to recognize the vital role that technical matter must play in reaching any agreement on arms control. The role of the scientist, as policy adviser, has strengthened this commitment, though sometimes it tends to obfuscate the political aspects of technical negotiation for arms control.

In the United States, and among scientists in favor of disarmament, there is a widespread belief that "the solution of the technical problems is certainly a prerequisite to the achievement of an acceptable agreement, and the form of available solutions is crucial for

²⁷ Ibid.

determining the possible types of accommodation."²⁸ On the other hand, as George B. Kistiakowsky, Special Assistant for Science and Technology to President Eisenhower, has pointed out, the determination from the viewpoint of national security of the adequacy of a monitoring system with a given degree of technical reliability is in the last resort not a technical question, and "political issues or disagreements cannot be resolved by technical agreements of facts."²⁹ This fundamental distinction between the adequacy and the reliability of a control system helps us to define the boundary, vague as it necessarily is, between political and technical considerations.

In 1958 the members of the President's Scientific Advisory Committee, headed by MIT President James R. Killian, were pressing for direct talks between the scientists of both sides.³⁰ Considering the novelty of this procedure,

²⁸This statement typifies the attitude of those who believe that the limits of technology set the limits of political compromise. Bernard T. Feld, "Inspection Techniques of Arms Control," in: Donald G. Brennan (ed.), Arms Control, Disarmament, and National Security, New York (1961), p. 317. This group believes that the main task of American experts, in the area of disarmament policy, is to invent technical systems that will surmount international distrust and thus make disarmament politically feasible.

²⁹In "Science and Foreign Affairs," Bulletin of the Atomic Scientists, Vol. XVI, No. 4, April 1960.

³⁰Reportedly, it was their pressure on the President, seconded by Dulles, that was instrumental in producing the former's letter to Soviet Premier Bulganin in April 1958 which suggested technical consultations on nuclear test detection. Saville R. Davis in Brennan (ed.), Arms Control, p. 388.

it would not be surprising if what Jerome Wiesner has said were true: namely that U.S. scientists went to Geneva with inadequate technical preparation to support their presentations.³¹

It can be surmised from public statements by Secretary Dulles, who was unquestionably the main artificer of policy at the time, that the Administration went into the Experts' Conference with a wait-and-see attitude. The U.S. position appears to have been as follows: if no great gap developed between the Soviet and American scientists on the requirements for verification, the agreement to suspend testing might be considered and the conference would pave the way for further political discussions; if, on the other hand, such a gap did develop, "that would almost automatically exclude any agreement."³² The lack of precision in the American approach probably reflected the Administration's internal division over the advisability of a test ban. The Western tendency to be pragmatic in approaching arms control negotiations contributed in a lesser degree to American vagueness. Western delegates seem to have developed positions toward verification as debate progressed in the conference. Lack of preparation before the talks may also explain, in part, the differences

³¹Jerome B. Wiesner, in Brennan (ed.), Arms Control, p. 200.

³²Department of State, Documents on Disarmament, 1945-1959, Vol. II, p. 1052.

that arose among Western scientists at Geneva.³³ There was also, however, latent friction between pro-ban and anti-ban scientists of the Western contingent.

The American propensity to view expert discussion in a predominantly technical perspective was strengthened by the generality of negotiatory goals. The Administration even considered that Western scientists might not need political guidance. Political advisers were sent to Geneva, but they played a secondary role. The aim was to avoid political issues and to insure a smoother and logical progress from acceptable data to sound technical conclusions. A conscientious effort was made to narrow the field of discussion to what was thought appropriate for technicians.³⁴ U.S. experts were told to look upon their job as a purely technical-scientific one. They were to come to their own conclusions as to what was necessary and were given complete authority "to work on this...as a purely scientific technical matter, to use their best judgment, and report... accordingly."³⁵

They were alerted, however, to the possibility of deliberate evasion of a test-ban treaty, a political problem at the heart of the long-standing U.S. position that effective control must form the basis of

³³U.S. Senate, Foreign Relations Subcommittee on Disarmament, Hearings on Disarmament and Foreign Policy, 86th Cong., 1st Sess., January 28, 1959, p. 32.

³⁴Ibid., p. 41.

³⁵Department of State, Documents, Vol. II, p. 1053.

agreement.³⁶ During the talks, the Western experts intentionally referred to the difficult cases of inspection, as "the ones which a control system would have to consider, since no one would seek to violate an agreement in an obvious and detectable way."³⁷ If the operational meaning of the approach suggested by the Administration to the scientists, is coupled with the spirit of this rule, it becomes evident that American scientists were being put in the position of having to formulate as well as negotiate policy. For the burden of determining how adequate the control system had to be to be acceptable was left for them to decide.

The technical implications of the Argus (high altitude) and Hardtack (underground) series of tests, conducted during and immediately after the talks, caused serious questioning of the capabilities of the control system devised at Geneva. Some political and physical scientists have severely criticized the performance of the Western technical experts as negotiators. The critics have alleged that they failed to appreciate the propaganda value of the final report; did not

³⁶An outline paper entitled "Technical factors which the Western delegation considers relevant to a discussion of monitoring nuclear test suspension" was sent to the Soviet Government through the United States Embassy in Moscow on June 24, in which "light and mobile inspection teams" were listed as one of the techniques of verification for various yields, including those less than one kiloton. The document also singled out the following special questions for consideration: (1) Are there methods of evasion, for example, can a 50 kiloton test underground be made to look like 10 kilotons, or 1 kiloton? (2) What about possible interference with detection systems, for example, the introduction of excessive noise in seismic systems? Reported in Verbatims, July 1, pp. 12-13.

³⁷Verbatims, July 28, p. 77.

sufficiently qualify correct but politically exploitable technical conclusions; permitted and even fostered undue optimism about the limitations of the control system; and "unwittingly...made some rather unfortunate political concessions which negotiators with diplomatic experience undoubtedly would not have made."³⁸

However, it was the decision-makers who set the guidelines of action for the experts. The negotiations were the responsibility of the Administration just as much as if they had been conducted by professional diplomats. Political advisers were present to state policy, identify political difficulties, and guide negotiation. That such a course was perfectly feasible is evident from the example of the Soviet delegation. As it happened, however, the belief that the technical and political aspects of national policy could be separated was just as strong among American decision-makers as among American scientists.³⁹ Had the policy-makers understood that the intimate relationship of political and technical factors is an integral part of the negotiatory process in joint technical discussions, they might have given different and more positive guidance to the Western experts.

Keeping politics out of the discussions proved only partially attainable. Especially during the initial phase

³⁸ Robert Gilpin, American Scientists and Nuclear Weapons Policy, Princeton University Press, 1962, pp. 208-211.

³⁹ Subsequent testimony would seem to indicate that it was technical people like Fisk and Foster who first indicated publicly the intimate relationship between the political and the technical.

and toward the end of the conference, Fisk had to impress repeatedly on his Soviet counterpart the Western position:

We hope that this inquiry can be kept exclusively technical. Our side is not empowered to discuss or reach decisions on any political matter. It will ease our deliberations if we are able to confine our discussion during the course of these talks to the technical issues we face.... The purpose of our meeting...is [to] understand fully and completely the methods, the techniques, all of the technical requirements which will be essential to detect and identify nuclear explosions.... Our primary responsibility as scientists is to provide those who must make important decisions with the factual foundations on which decisions can be made. I believe that as we proceed through the details of the technical matters before us, we will...be in a position to provide just such technical information for our principals.⁴⁰

Six weeks later, Fisk told Fedorov that many of the points raised were political and not susceptible of discussion by this technical Conference. "I can only repeat that statement. Political points are not for us to discuss."⁴¹

As will be shown in more detail below, the nature of the Soviet objectives and the exigencies of negotiation prevented the West from keeping the discussions entirely free of political debate and bargaining.

⁴⁰Verbatims, July 1, pp. 12, 32, 37.

⁴¹Verbatims, August 12, p. 61.

B. THE EAST: A POLITICAL IMPERATIVE

A four-minute suspension of the third plenary session on July 4 marked the end of the initial phase of the conference of experts and the beginning of what can properly be called the technical discussion. Before then, debate had revolved around a determined effort by the Eastern delegation to get a commitment from the West to renounce tests.⁴²

From the very opening of the conference, the main concern of Fedorov, Soviet head of delegation, had been to extract from his opponents a pledge that agreement would lead to test cessation. He made it plain that the only important Soviet purpose was to see:

That the United States and Great Britain also halt tests.... It seems to us that the purpose of our conference and of the measures which, in our view, should be taken after this conference is the all-round cessation of nuclear and hydrogen weapons tests. In our view, only for that purpose is it worth spending time on a discussion of the technical aspects of the question.... In approaching this work, we, the experts on the Soviet side, should like to know this: do you agree that the work of the experts should and must lead to a solution to the main problem, namely, the cessation of tests of nuclear and atomic weapons by all the powers? We should like

⁴²A one day recess had preceded the session. During this the Eastern delegation presumably asked and received instructions which broke the deadlock.

to have from you and all your colleagues,
Mr. Fisk, a very clear and unequivocal
answer to that question.⁴³ [Emphasis supplied.]

The Western side unequivocally answered that the question was political and therefore out of order. Fedorov had been tenacious in his efforts, but he finally admitted that the positions of the two sides on the basic aim of the conference differed. Expressing regret that his Western colleagues had not been able to provide "a satisfactory answer to the question...asked regarding the aim of the conference," he nevertheless conceded that "a definite general basis for...work existed." He proposed an agenda that was clearly oriented toward technical discussion, and the West accepted it.⁴⁴

Although it cannot be said that the Eastern experts gave up all efforts to raise political issues, most other attempts to secure a Western commitment to purely political aspects of verification came toward the end of the conference. The most blatant of these arose during the discussion of the organization for a full control system, the final item on the agenda, and concerned the staffing of control posts.

On July 30, the Communist delegates started probing to elicit Western agreement to the notion that control posts should be staffed by scientific personnel from the country in which the post was located. Evidently their

⁴³Verbatims, July 1, pp. 17, 27, 28-30.

⁴⁴Verbatims, July 4, pp. 3-10.

questions were designed to provoke the West into a retort that was more political than technical, and thus to extend the scope of the talks. Would such a post be able "to carry out observations from a technical point of view... if it [was] staffed only by representatives of one side alone?"⁴⁵ Eastern pressure was not deflected by Fisk's firm rebuttal: "This is really not a technical question, Dr. Fedorov. I suspect that this would require some debate by others than ourselves. The real technical requirement is for scientific and technical competence."⁴⁶ The Soviet attempt to bring this matter to debate continued sporadically,⁴⁷ and ended with a final but unsuccessful attempt on August 12, when the Rumanian, Hulubei, devoted his whole presentation to the problem of staffing the control system. Hulubei offered the suggestion that a small number of representatives from outside the country to be inspected might be allowed to join the staffs of the control posts. The Rumanian noted that in the context of control countries could be divided into three main groups -- "namely, those forming part of the Warsaw Pact; those affiliated with one of the other military pacts such as NATO, the Baghdad Pact, [and] SEATO; ...and countries...."⁴⁸ Yet he denied that what he had said

⁴⁵Verbatims, July 30, p. 76.

⁴⁶Ibid.

⁴⁷Verbatims, July 31, pp. 32-35 and August 5, pp. 71-82.

⁴⁸Verbatims, August 12, pp. 52-55.

related to a political aspect: "That is not so, and... these general suggestions are as technical as those made earlier in connection with equipment...."⁴⁹

The question of staffing control posts, then, brought out two of the most palpable illustrations of the political imperative under which the Communists operated. Less obvious, but more important for the purposes of this study, was the highly political approach of the Eastern delegation to scientific and technical matters. This approach made the Geneva experts' talks a political negotiation, notwithstanding the primarily technical content of debate. What happened may best be understood by analyzing the attitudes of both sides toward the problem of detecting and identifying violations of a test-ban treaty.

⁴⁹Ibid.

IV. THE CAPABILITY TO DETECT AND IDENTIFY VIOLATIONS

Although constructive negotiation is an effort to reach agreement through compromise, it is also a form of conflict. Hence, in an international frame of reference, the various negotiating parties determine what facts are relevant. Their differences over what is relevant are based on attitudes, opinions, ambitions, misunderstandings, and suspicions that do not appear in their formal positions, but in fact influence their interpretations of the opponent's position and condition their perceptions of the empirical evidence presented. The interpretations of the various parties may be subjective enough to differ substantially, however full the available information about the non-political factors under discussion. As Quincy Wright put it: "False images depend not on misinformation about the immediate situation, but on prejudiced conceptions and attitudes rooted in...history, in the national culture, or in the minds of important persons in the decision-making process."⁵⁰

The discussion and the interpretation of empirical data (as distinct from established scientific principles) are subject to debate not only over the validity of related theoretical assumptions but also over practical implications and applicability. Therefore, technical conferences involve negotiatory situations that may differ little from those associated with political conferences. (This point is discussed further in Section V.)

⁵⁰ Memorandum on International Conflicts, Carnegie Endowment for International Peace, New York, December 1955, pp. 5, 6.

The formal task of the experts in 1958 was to investigate the feasibility of detecting and identifying clandestine explosions by a signatory power of a nuclear test-ban agreement. Presumably no firm and detailed conclusions had been reached on this subject by either Western or Communist scientists prior to joint consultation. It does not appear that Western scientists thought detection, or even identification, difficult to such a degree as to preclude a controllable test ban.⁵¹ The Russians had openly expressed their confidence that the problem presented no particular technical difficulties.⁵² A major share of their effort at the conference was expended in the attempt to prove this contention. Western delegates, particularly Americans, on the other hand, strenuously emphasized the difficulty of the undertaking. The British seemed to mediate when the two big powers reached an impasse.⁵³

A. EASTERN OPTIMISM VERSUS WESTERN REALISM

The tendency to divorce technology from politics caused Western scientists to be more sensitive about the inadequacy of available data. Their realism with respect to the possibility of detection and identification, turned into pessimism whenever their Communist opponents manifested

⁵¹See Fisk's remarks at the beginning of the conference in Verbatims, July 2, pp. 4-5.

⁵²Verbatims, July 1, pp. 22-25, and July 2, p. 37.

⁵³See remarks by Sir Edward Bullard and by Sir William Penney in Verbatims, July 16, 1958, p. 31, and August 5, p. 36, respectively.

obviously political aims. To the Communists, on the other hand, an optimistic approach to the relevant data meant that there seemed to be a good chance for reaching agreement in the experts' talks and of inducing the United States and Britain to declare a test moratorium.⁵⁴ Typical of the difference of attitude between the two sides is an exchange between Federov and Fisk during the plenary session of July 28:

FEDEROV: We have already discussed together five or perhaps more methods for detecting explosions and have adopted the conclusions concerning their possible utilization.... I would like to note, however, that the objective of the [Western speakers] seems somewhat strange to me.... The second and third speakers particularly expressed a number of pessimistic comments as to how difficult it will be to catch a violator, and list various arrangements he might arrive at in order to hide this or that explosion.... I think I can say that neither I nor my colleagues could agree with the pessimistic deductions or theoretical possibilities of violation which have been expressed in these statements.... In all cases there are methods which will permit the detection of...explosions....

FISK: I should not like...to leave this discussion without a remark on the question of scepticism versus optimism, to which reference has been made.... Our intention was to be neither pessimistic nor unduly optimistic. The fact that we seem to have referred to difficult or pathological [sic] cases is, of course, intentional. These

⁵⁴E. K. Federov, "The Agreement on the Cessation of Nuclear Tests Must be Concluded Without Delay," Bulletin of the Atomic Scientists, October 1959, p. 329.

cases seem to us to be the ones which a control system would have to consider....⁵⁵
[Emphasis supplied.]

Representative of the statements alluded to by Federov was a summation by one of the American specialists which pointed out that none of the proposed detection methods would remove the difficulty of deciding whether a given event was natural or man-made. With the acoustic method, for example, this kind of difficulty might occur perhaps 100 times a year. With electromagnetic detection, said a Western delegate "one will have to establish a discrimination technique which is unambiguous -- something like 1 minus 10^{-7} or 10^{-8} of the time.... We have very little information on the possible similarity of other...disturbances or phenomena.... We are faced with this...on each of our detection methods and in all our environments."⁵⁶

The extent to which the differing approaches to the objectives of joint technical study impinged upon the technical discussion is best illustrated in the debate that took place during the presentation of each method of detection.

⁵⁵Verbatims, July 28, pp. 62-65, 77.

⁵⁶Ibid., p. 61. The conference examined the effectiveness and limitations of the acoustic, hydro-acoustic, seismic, electromagnetic, and radioactive debris collection methods for the detection of nuclear explosions. The environments referred to are: surface, underwater, underground, and high altitude.

1. Acoustics

Generally speaking, the Eastern scientists tended to be qualitative, theoretical, and optimistic about verification, while the Westerners were quantitative, empirical, and inclined to face the difficulties in advance. This difference prevailed from the start. The first item on the agenda was the acoustic method of detection.

Soviet scientists emphasized the ease with which sound waves caused by explosions could generally be detected. In discussing the propagation of wave signal distribution, they stressed that electromagnetic waves from a nuclear explosion carried "over very long distances through natural wave barriers."⁵⁷ The Western reaction typically underscored the difficulties. Rocard, the French delegate, noted the general validity of the presentation but asked the Russians to "admit as of now that there occur substantial variations in the signals received from one point to another on the earth?"⁵⁸ His British colleague warned: "The speakers we have heard this afternoon have been talking about picking up waves by barographs and they have

⁵⁷Brekhovskikh in Verbatims, July 4, pp. 23-25, 27-30. In this section, and in all subsequent sections dealing with technical and scientific materials, the analysis presented is invariably concerned only with showing the difference of approach and attitude between the scientists of the two sides. No attempt is made to discuss the scientific validity or significance of the data or theories quoted or mentioned.

⁵⁸Ibid., p. 42.

been saying it is easy; of course it is easy if you have very big explosions.... It seems to me that we must think of small explosions and...the sensitivity of the instruments."⁵⁹

Eastern optimism remained undaunted, as Gubkin, USSR, retorted, "The sensitivity of the equipment at present can be so great as to eliminate lengthy discussion.... The experiments I have studied show that in explosions of several kilotons, signals are registered over a distance of several thousand kilometers, and they can be registered sufficiently clearly.... If we have a network of stations, then it would be sufficient to have registration by three stations of the signal, and then the place will be determined."⁶⁰

Western scientists focused their presentations on the experimental aspects to complement the theoretical papers read by the East. It was pointed out that the 'medium through which the acoustic waves are propagated from the explosion to the detection station is extremely variable and unpredictable...and to a certain extent...[the] actual temperature structure of the atmosphere makes it very difficult to interpret...actual experimental measurements in terms of pure theoretical treatments.... There are great difficulties in predicting some of the odd experimental phenomena on the basis of simplified theoretical concepts At least in our [Western] point of view, the amplitude of the acoustic record from an explosion is a very difficult thing to use for any quantitative interpretations."⁶¹

⁵⁹ Ibid., p. 56.

⁶⁰ Ibid., p. 66.

⁶¹ Ibid., July 5, pp. 6, 7-10, 11.

The duel between the two sides over whether detecting nuclear explosions by acoustic means would be relatively easy or difficult continued through the discussion of this method, and did not lack semantic inventiveness. The Russians presented a high probability curve for acoustic detection, based on observations taken downwind from explosions, i.e., in the more favorable conditions for detection.⁶² The West pointed out that while some downwind signals were fairly large they were not uniformly so. Moreover, crosswind stations would generally have to expect poor signals.⁶³

When discussing the problem, introduced by the West, of distinguishing an artificial explosion from a natural one, the Russians expressed this view: "Without any criticism,...if we are going to speak of the hindering phenomena, including the common and uncommon hindrances such as the explosions of volcanoes and meteorites of unusual magnitude, then we shall be constantly departing from the basic purpose of our discussion."⁶⁴ The difficulty of detecting a small explosion, they said, would be eliminated quite easily by the use of more sensitive instruments.⁶⁵

⁶²Verbatims, July 8, pp. 52-55, 58-60.

⁶³Ibid., p. 36.

⁶⁴Ibid., July 5, p. 47.

⁶⁵Ibid., July 7, pp. 31-50. For further examples in the same source, see Verbatims, especially for the plenary sessions of July 5, 6, and 8.

2. Seismics

The possibility of detecting an underground event and then identifying it beyond doubt as either an explosion or an earthquake has stimulated the most lively debates on the technical aspects of the proposed nuclear test ban. Particularly intense has been the controversy over "decoupling" as a method to violate a ban clandestinely.⁶⁶ The decoupling theory appeared after the 1958 negotiations. It threw grave doubts on the detection capability of the system proposed by the experts.

The problem of detecting a small-yield underground explosion, however, was raised at the 1958 talks, and it too exemplified the contrast between Eastern optimism and Western pessimism. Having discussed some of the capabilities of the seismic detection method, Western scientists pointed out some of its handicaps. The very large variations in noise would make the detection capability of a given system of stations vary appreciably between summer and winter. In addition, interference from large earthquakes could impose severe restrictions on the system even on the quietest days. Finally, it has been estimated that

⁶⁶This theory, first suggested by A. L. Latter, was investigated at RAND by A. L. Latter, R. E. Le Levier, E. A. Martinelli, and W. G. McMillan, who calculated that nuclear explosions could be hidden in large underground cavities, thus effectively reducing seismic signals by a factor of 300. See A. L. Latter and others, A Method of Concealing Underground Nuclear Explosions, The RAND Corporation, R-348, March 30, 1959, and R. Latter and others, Detection of Nuclear Explosions, The RAND Corporation, P-2399, August 2, 1961.

there are more than 6,000 earthquakes per year of a magnitude larger than 4-1/4 (Richter scale), which is approximately that of the U.S. underground nuclear explosion of September 19, 1957. Hence, the problem of identifying blasts from seismic data alone is a very difficult one.⁶⁷

Communist experts once again chose to minimize the difficulties of detection. Speaking of underground blasts, Pasechnik of the USSR maintained that in an explosion, just as in an earthquake, elastic waves of different types are created, including surface waves. "According to the magnitude of these waves," he said, "it is possible to determine the time and location...[and] the yield of the explosion."⁶⁸ In fact, in the case of underground and underwater explosions there is a share of energy "forty times greater than the one which might occur in the case of an ordinary explosion.... This explains [why in such cases] seismic waves can be recorded at considerably longer distances than in the case of explosions in the air at high altitude of similar magnitude."⁶⁹

In distinguishing nuclear blasts from earthquakes the East foresaw no insurmountable difficulty. Criteria were presented to show that the seismic waves produced by an earthquake could be distinguished from those produced by a

⁶⁷Ibid., July 14, pp. 17-21.

⁶⁸Verbatims, July 14, p. 46.

⁶⁹Ibid., pp. 47-50.

detonation.⁷⁰ According to Pasechnik:

It would seem...that the criteria... referred to, permit us to distinguish between records of explosions and records of earthquakes.... The overwhelming majority of earthquakes will be excluded from discussion as a result of a...number of well-established factors in connection with the readings of seismograph operations by seismologists. Exclusion would be immediate for deep underground earthquakes,...for such earthquakes as would yield records of Love waves as well as of the aftershocks, and [for] those not too distant from the registering centres.... Thousands of small shocks will also be excluded from consideration.... There will perhaps remain a very small number of records, say five or ten a year, but certainly not thousands as Dr. Fisk

⁷⁰The greatest significance was attached to the straight longitudinal p-waves recorded from a distance of 10⁰ and more, for the purpose of detecting nuclear explosions and for determining their location. (Verbatims, July 17, p. 106). This general theory of the direction of the first motion, i.e., that explosions will always give an "upward" or compressional first motion of the seismograph needle, while earthquakes will give a downward motion at about half the stations, later became another bone of contention between pro-ban and anti-ban scientists in the United States. Deriving its theoretical underpinning from the 1957 Rainier underground explosion and the later 1958 Hardtack II test, it remained controversial and has not been disproved. See, for example, Jay Orear, "How Feasible is a Test Ban?" and Arthur H. Rosenfeld, "What About the Undetectable Tests?" in Bulletin of the Atomic Scientists, March 1959, and Harold Brown, "Detection and Identification of Underground Nuclear Explosions," Ibid., March 1960, and L. Don Leet, "The Detection of Underground Explosions" in Scientific American, June 1962.

indicated -- five or ten, I say, which might raise some doubt.⁷¹

Moreover, Eastern scientists felt that a clandestine explosion against the background of an earthquake could practically always be identified and separated through the combined study of all the records obtained by the several seismic stations surrounding the epicenter.⁷²

In contesting the other side's conclusions, American scientists reintroduced the distinction between answers based on theoretical and experimental evidence, the latter being in their view more useful for the purposes of the conference.⁷³ Not all questions involving underground explosions and earthquakes were settled during the debate on the seismic method. As late as July 31, while discussing the control network, the West was still stressing the difficulty of distinguishing between small earthquakes and one

⁷¹Pasechnik in the plenary session of July 14, pp. 68-70, 76, 77-80.

⁷²The Soviet Union has consistently maintained that underground explosions can be detected with existing methods of detection, at first with the Geneva system (E. K. Federov, "Controlled Cessation of Atomic Weapons Tests," Bulletin of the Atomic Scientists, January 1959), later merely with existing national detection systems (Conference of the Eighteen-Nation Committee on Disarmament, Sub-Committee on a Treaty for the Discontinuance of Nuclear Weapon Tests, Verbatim Record of the First Meeting, March 21, 1962, p. 9). The epicenter is a point at the earth's surface directly above the focus of an earthquake or an underground explosion.

⁷³Verbatims, July 14, p. 106.

kiloton nuclear explosions.⁷⁴ But then the specific technical problem of detecting and identifying underground explosions was the most difficult confronted by the experts.

In addition, the Russians probably had no data on underground explosions since, it would seem, they had not conducted any relevant tests before or during the conference. This might have increased their tendency to talk about theory rather than experience. It must be noted that the West itself had data from only one experiment (the Rainier shot).⁷⁵ Lack of Soviet experimental data did not eliminate, but merely abated Communist optimism about the efficacy of the seismic method of detection, although this attitude was somewhat modified by the Western scientific presentations and the American data that were introduced to counter Soviet theoretical arguments.⁷⁶

3. Electromagnetics

The experts also discussed the detection of electromagnetic radiation as a method of verification for a test ban. This question involves the following basic considerations:

The high frequency end of the electromagnetic spectrum (X-rays, ultraviolet) is quickly absorbed in the atmosphere and

⁷⁴Ibid., July 14, p. 81.

⁷⁵U.S. Senate, Subcommittee of the Committee on Foreign Relations, Hearings on Disarmament and Foreign Policy, January 28, 1959, 86th Cong., 1st Sess., pp. 14, 15.

⁷⁶Verbatims, July 31, p. 81, and July 18, 1958, pp. 6, 16, 47-50, 82.

converted to lower frequency electromagnetic energy and molecular energy. Thus an appreciable part of the bomb energy travels in the regions of the electromagnetic spectrum where there is little atmospheric absorption: namely as visible light and noise. Detection of the visible light at distances of 300 miles is quite simple.... As long as the test is not...underground, a very distinctively shaped light pulse will be observed.⁷⁷

The main limitation of electromagnetic radiation detection is the weakness of secondary scatterings. Detection, however, was not the main problem faced by the Geneva discussants, for concerning the transmission of electromagnetic signals from a nuclear explosion there was reasonably close agreement between theory and experiment.⁷⁸ More important was the matter of identification.

The electromagnetic method caused less controversy than the other methods, but manifested the same pervasive difference of approach between the two sides. The East expressed the opinion that "through electro-magnetic radiation and radio signals it is possible not only to detect a nuclear explosion but to determine the place and time of its occurrence, and also to distinguish a nuclear explosion from an interference signal [emphasis supplied]."⁷⁹

⁷⁷ Seymour Melman (ed.), Inspection for Disarmament, Columbia University Press, New York, 1958, pp. 93-94.

⁷⁸ R. Latter in the plenary session of July 21, p. 37.

⁷⁹ Verbatims, July 18, pp. 97-100.

The West, on the other hand, indicated a number of reservations. Since it appeared that the gamma-ray yield determined the strength of the electromagnetic signal, and since variations of as much as a factor of ten had been observed -- with an explosion having substantial amounts of absorbing material around it -- it seemed that the total yield was not a good criterion for measuring the detectability of nuclear explosions by electromagnetic means.⁸⁰ Moreover, by prevailing methods adequate identification was difficult. With the knowledge available to the conference, the West contended, it is clear that "even kiloton bursts in the air may under certain circumstances be difficult to detect at moderate distances, if at all possible."⁸¹ For even quite shallow sub-surface explosions, the electromagnetic signal would be negligible at any significant distances. Lightning flashes are the main source of interference, and may give signals indistinguishable from those of nuclear explosions. Finally, it was observed "that unique identification will not be possible by electromagnetic means alone [emphasis supplied]."⁸²

⁸⁰ Ibid., July 21, p. 36.

⁸¹ Ibid., pp. 38-40.

⁸² Ibid., p. 41. See The Conclusions on the applicability of the electromagnetic technique to the detection and identification of nuclear explosions tabled by the Western delegation at the plenary session of July 21, 1958. No electromagnetic signals were picked up by experimental stations in the U.S. from the 1957 (Rainier) underground explosion. (EXP/NUC/PV. 17, p. 22).

The discussion of the electromagnetic method led to consideration of the detection of high altitude explosions.⁸³ Since experimental data were not available, the experts treated this question only as a theoretical one. They did not design means to detect space explosions.⁸⁴ It was not until the summer of 1959, after another East-West technical conference, Technical Working Group I, that control measures for space explosions were agreed upon.⁸⁵

On July 25, 1958, both sides agreed to a joint set of conclusions on the electromagnetic method. Agreement was reached through the expedient of private meetings. The text blended the optimism of one side with the relative pessimism of the other. Upon Soviet insistence, the phrase "radio signals" was substituted for the term "electromagnetic."⁸⁶

⁸³Verbatims, July 22, pp. 55 ff.

⁸⁴Ibid., July 28, pp. 3-15.

⁸⁵This conference agreed on a final report that recommended a system of earth satellites and ground-based equipment to monitor space. Agreement was reached on the difficulty of detecting outer space testing, and the possibility of shielding explosions was noted. Soviet scientists, however, did not agree to the inclusion of backscatter radar into the control system, claiming that it was a tool for espionage. See Conference on the Discontinuance of Nuclear Weapon Tests, Technical Working Group on the Detection and Identification of High-Altitude Nuclear Explosions, Verbatim Record of the Twentieth Meeting, and Report of the Technical Working Group on the Identification of High-Altitude Nuclear Explosions, Document 63, July 10, 1959.

⁸⁶Verbatims, July 25, pp. 6-8.

4. Nuclear Débris

The discussion of nuclear débris collection as a method of detection was quite dramatic and, by raising the question of on-site inspections and sample-collecting air flights, anticipated some of the most violent debate at the subsequent Geneva political conference. The matter of underground tests also continued into this phase of the joint discussions.

In the investigation of radioactive débris, the East continued to underestimate the difficulties of monitoring a test ban, while the West countered with its customary realism. The exchange between Sadovski of the USSR and Brown of the U.S. on July 21 illustrates well the tenor of the discussion:

SADOVSKI: It is not so much that I want to ask a question, I simply wanted to express a certain amount of optimism and to drop it into the sea of pessimism which Dr. Brown has pictured. It seems to me that the specific peculiarities of an underground explosion will lead to the situation that the area where they will have to be sought will after all be limited.... As for violations in a seismic area it would seem to me that, if we were to come to the logical conclusion of having to use, apart from a network of control stations, also normal seismic networks... then we will find ourselves in such conditions where the determination of the position of the epicentre will be effected with a sufficiently high degree of accuracy, and this already can eliminate very many of the difficulties to which Dr. Brown referred.⁸⁷

⁸⁷Ibid., July 21, p. 97.

Brown had noted that "a nuclear device could be detonated underground, with careful planning and execution, in such a manner that post-shot...visual and geophysical inspection would probably not locate the site with sufficient accuracy to allow successful drilling for radioactive debris. Under such circumstances, proof of a violation by technical means...would be lacking."⁸⁸ In the case of the Rainier shot, Brown argued, although the position of the detonation was known to within a few feet, it required several weeks of drilling from a point in the tunnel only 200 feet from the site before samples of solid radioactive material could be produced.⁸⁹ When signals could not definitely be identified as emanating from natural phenomena, it would be necessary to send mobile inspection teams to the source to determine whether a nuclear explosion had occurred, i.e., to initiate on-site inspection of a suspected underground nuclear test. (Both sides had talked about this need earlier.) "The number of such investigations," said Brown, "will of course be greater the wider the spacing of a network, because the wider the spacing the less indications will be obtained remotely."⁹⁰ The Eastern delegation accepted in principle the idea of mobile inspection teams for checking a suspected nuclear explosion,⁹¹ and reserved

⁸⁸Ibid., pp. 82-85.

⁸⁹Ibid., p. 81.

⁹⁰Verbatims, July 21, pp. 54-60, 61.

⁹¹Ibid., August 1, p. 12.

its strongest objections for the Western demand that aircraft sampling flights to collect radioactive debris be included in the monitoring system on the ground that they were essential for certain kinds of identification.

The sensitivity of the Russians about flights over their territory needs no elaboration; it has been made manifest with monotonous regularity. It is not surprising to learn, therefore, that Fedorov, head of the Communist delegation, argued at Geneva that although the Soviet Union had utilized aircraft to gather radioactive products for analysis, spending "many flying hours with large aircraft in order to fish out of the atmosphere these products," it later "came to the conclusion that this was not a particularly valuable way of doing it."⁹² He thought there was no need to undertake these rather expensive flights, "particularly...as a definite routine system for the purpose of gathering the required amount of radioactive products. [They] can be gathered at ordinary surface filtering installations [about] 10 days after the explosion...."⁹³ The West "agreed...with all the scientific data...advanced," but suggested that Dr. Fedorov's conclusions were somewhat optimistic.⁹⁴ Moreover, the Western draft for the conference's conclusions on radioactive debris collection specifically stated:

Existing apparatus of special design can
be mounted on aircraft and used to collect

⁹²Ibid., July 10, p. 26

⁹³Ibid., p. 27.

⁹⁴Ibid., p. 52.

adequate samples of débris from a 1 kiloton explosion at a distance of two to four thousand kilometres in average meteorological conditions.... [Otherwise] sampling closer than a thousand kilometres is necessary.... The site of the explosion can be located within a few hundred kilometres under...favorable conditions if adequate samples have been collected within 1-2 days.... Aerial collection of débris can be supplemented by ground stations.... However, in general the samples are less reliable since they are likely to be contaminated and may be several weeks old.⁹⁵

The debate over the air sampling issue was long and hard.⁹⁶ Fisk of the United States argued that the Western demand for air sampling flights was based on extensive experience, and that the qualitative arguments brought forward by his opponents to suggest that sampling at ground level would meet all important requirements were not persuasive.⁹⁷ Federov pleaded that from "a position of principle, aircraft [were] quite unnecessary for these operations." Moreover, they would "probably cost much more than the whole of the control system."⁹⁸

The impasse was resolved, characteristically, by a

⁹⁵Verbatims, July 10, pp. 62-63.

⁹⁶See for example the plenary sessions of July 10, 11, 12, 15, and 17.

⁹⁷Verbatims, July 17, p. 22.

⁹⁸Ibid., July 11, pp. 53-55.

political compromise. The final report of the conference stated inter alia:

In the course of the period of time from two to five days after an explosion of [a 1-KT bomb] the collection of a sample of radioactive debris...can be effected in the air by an aircraft.... The utilization for a regular control service...of the taking of samples...by aircraft over the oceans can be used.... Search for the radioactive cloud can be made on an aircraft.... In some cases use can be made of aircraft flights over the territories of the USA, the USSR, the UK and other countries to collect air samples....⁹⁹

Western pessimism, though qualified, seemed justified.

In sum, it would seem that reaching a technical consensus in a negotiatory forum depends crucially on the attitudes and the assumptions brought to the conference by the expert representatives of the negotiating parties. These attitudes, in turn, may be hardened or softened by the negotiatory goals of the respective governments and by the scope of discussion defined in the agenda. Specific technical knowledge does not usually suggest negotiatory goals but may limit the area of negotiatory maneuver in a technical debate between political antagonists.

B. PROBABILITY AND THE QUESTION OF VIOLATORS

The self-acknowledged optimism of the Communist experts

⁹⁹ Report of the Conference of Experts to Study the Methods of Detecting Violations of a Possible Agreement on the Suspension of Nuclear Tests, August 20, 1958, pp. 8, 9.

and the relative pessimism of their Western colleagues with respect to the capability to detect and identify violations of a test ban seems to have influenced the assessments made by the two sides of the probability of violations. This question also divided American scientists both at home and in Geneva.

The question of probabilities was a recurrent theme of discourse between the expert delegations at Geneva in 1958.¹⁰⁰ Scientific explanations, probabilistic (i.e., statistical) explanations, and "unreasoned" predictions, as well as political preferences, vied with each other as the delegates attempted to determine the likelihood of test-ban violations.¹⁰¹ The question naturally came up most frequently during the discussion of the network of posts, or system of control, though debate on violations occurred from time to time throughout the conference.

¹⁰⁰ It is convenient to distinguish three concepts of probability: (1) relative frequency, (2) degree of confirmation and (3) subjective, or personal, probability. "Of these, the first is an objective, empirically ascertainable property of classes of physical objects or physical events; the second is also purely objective, namely, a logical relation between sentences; the third is a measure of a person's confidence that some given statement is true and is thus an essentially subjective matter." Olaf Helmer and Nicholas Rescher, On the Epistemology of the Inexact Sciences, The RAND Corporation, Report R-353, February 1960, p. 14.

¹⁰¹ Helmer and Rescher have characterized a scientific explanation as one that "consists in the logical derivation of the statement to be explained from a complex of factual statements and well-established general laws." For explanations of probabilistic and "unreasoned" predictions see Ibid., pp. 10-12.

Judgments as to what constituted "the facts" and some of the methods used to reach conclusions from sample observations were challenged by one side or the other. In the debate on test-ban violations, the values assigned to "probability" came to depend on the tenacity with which each side advanced its opinions concerning "the facts" and their evaluation. Often, when discussion turned to the probability of violations, subjective estimates were presented. Since basic assumptions remained tacit, differences of opinion abounded concerning the conclusions flowing from them.

Observations on the probabilities of violation pivoted upon the effectiveness of the proposed system for detecting, identifying, and perhaps deterring violations.¹⁰² Controversy arose in connection with the network of stations, their instrumentation, the technical competence and national make-up of the staff, access to records, time delay in the communication of data, and the control organization operating the system.

The problem of detecting underground explosions and distinguishing them from earthquakes was a central one in determining the spacing of control posts in the verification

¹⁰²The West had originally argued that the final report to the governments should include conclusions on a number of systems of detection; the Russians steadfastly insisted that the conference propose one system. The West finally agreed to discuss the 170-post system proposed by the British, as a compromise between an original Western system of 650 posts and the Eastern proposal for a network of 110 posts. Verbatim, August 5, p. 61. The latter decoupling theory made this preoccupation superfluous for clandestine underground events.

system. The Western experts selected three parameters as essential to the design of the system:

(1) the minimum yield that the system should be capable of detecting and identifying,

(2) the probability that the system would detect and identify an event with this yield, and,

(3) the number of global posts needed to provide the desired coverage.

With a one-kiloton underground event and 110 control posts (Communist proposal), the probability of detecting and identifying would have been about five per cent. If the network included 650 stations (initial Western suggestion), the probability of achieving detection and identification of a one-kiloton detonation would have been ninety per cent. A system having 170 posts (the compromise Western suggestion of August 5) would have given a ninety per cent probability of detecting and identifying events of a five kiloton yield.¹⁰³

Each detection system would have had a capability which varied according to the desired probability of detection and identification. This probability depended, to an essential degree, on the size of the detonation, the number and arrangement of control posts, the sensitivity of the instruments at each post.¹⁰⁴ In 1958, this meant

¹⁰³Verbatims, August 5, pp. 27-35.

¹⁰⁴This approach was suggested by the Western delegation in order to permit agreement since the Russians seemed adamant on a small number of control posts. U.S. Congress, Joint Committee on Atomic Energy, Hearings on Technical Aspects of Detection and Inspection Controls of a Nuclear Weapons Test Ban, 86th Cong., 2d Sess., 1960, pp. 19 ff.

that a 1 KT detonation would have required more posts than a 5 or 20 KT blast. Similarly, if a lower probability of detection was acceptable, then the number of control posts could be reduced. A still smaller network might have been adequate if the detonation threshold was raised. Again, the number of posts required might be reduced by increasing the number of physical inspections -- a fourth variable.¹⁰⁵

Since the spacing of the seismic grid and the number of on-site inspections of unidentified seismic events are directly related, a system with a poor capability for identifying earthquakes of a relatively low kiloton energy equivalent would have to be reinforced with a relatively high inspection capability.¹⁰⁶ In the Soviet view, however, a greater number of posts or of inspections was undesirable because it would bring more intrusion by the control organization into Soviet territory. The Communists, therefore, argued for a smaller control network and a higher detonation threshold. Not all arguments were empirically tenable. "Probabilities" were influenced by political imperatives, and a number of "unreasoned" predictions were made.

The following examples show how scientific and subjective arguments intertwined whenever, in the debate, the

¹⁰⁵ Another method of increasing the capability of the system was suggested when American data obtained after the close of the talks challenged the conference's conclusions. The new method was to increase the number of seismographs at each station, putting them in a "battery" arrangement. U.S. Senate, Subcommittee on Disarmament of the Committee on Foreign Relations, Hearings on Disarmament and Foreign Policy, 86th Cong., 1st Sess., p. 177.

¹⁰⁶ Bacher, United States, Verbatims, July 30, pp. 47-50.

political implications of the material being discussed rose to the surface. After the Eastern delegation had presented its quantitative evaluation of the capability of a control network of posts, based on single-station acoustic detection, the West presented its own view. Western scientists regarded two-station acoustic detection as the essential basis for a control system, and challenged the notion that a combination of the acoustic and radio-signal detection methods would be particularly effective for tropospheric bursts. Western conclusions on these methods, taken separately, reflected uncertainty as to the extent to which discrimination between lightning flashes and bomb signals was possible at large distances. Secondly, and more important from the point of view of violations, the Western delegation contended that shielding of the radio signal from a small explosion was very easy. The disadvantages of single-station acoustic detection were also explained. Moreover, the West noted that a two-station system would considerably reduce the area for on-site inspection.¹⁰⁷ The Russian Gubkin related the question of probability to the two-station concept as follows:

The figures of probabilities of detection by means of two stations referred to two sets of conditions favorable and unfavorable. Presumably in the case of favorable

¹⁰⁷ A two-station system arranged geometrically within the seismic grid network of control posts would make it considerably more likely to localize an event. However it might increase the total number of stations. See Verbatims, August 11, pp. 37-47.

conditions Dr. Turkevitch [U.S.] took an average noise level or some sort of noise distribution related to favorable conditions. The same thing applies to unfavorable conditions. Those are rather low figures for a probability of detection by means of only two stations.... It therefore follows that for two stations out of twelve to record, the probability should be rather high and that such low figures could be obtained only under conditions of very high noise....

When we multiply the probability of detection by five seismic stations and then multiply by the probability of identification of a given signal, as a signal from an earthquake, and then require that 90 per cent of the cases be recorded, it might be possible to achieve identification.... But in that way we would arrive at an infinite number of stations.¹⁰⁸ [Emphasis supplied.]

The Russians, though appreciating the work done by their Western colleagues especially for its concentration on the realities of the problem, suggested that someone else undertaking the same study might arrive at a different number of stations. They expressed the opinion that "such studies are always dependent upon the person who undertakes them."¹⁰⁹ They remained unconvinced.

The Western delegation briefly explained how it obtained a value for the probability of identifying an earthquake as a natural event. Brown, United States, explained that this

¹⁰⁸ Verbatims, August 11, p. 51.

¹⁰⁹ Ibid., p. 52.

probability was obtained by a summation of the products of two separate probabilities: One, the probability of getting "N" station detection; and the other, the probability that with "N" station detection of "first motion," the phenomenon could be identified as natural. This is then "summed up over various numbers of detections":

The first number is obtained just by using a Gaussian distribution¹¹⁰ with a mean number of stations detecting in a dispersion which represents the width of the Gaussian curve.... The second number is the probability that, given "N" station detection, you will get an identification as an earthquake. And what was used in our evaluation was just the statement that the compression and rarefaction are random, and that if you get two rarefactions, it is an earthquake. This is consistent with our statement in the conclusions that, with five or more stations, first motion detection, you will have 90 per cent or more probability of identification....¹¹¹

¹¹⁰Distributions are associated with random variables and give the relative frequencies with which these variables take on values in their domain. The Gaussian distribution is one where these frequencies are given by the expression

$$\frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-m)^2}{2\sigma^2}}$$

¹¹¹Verbatims, August 11, pp. 57, 58-60.

The Czech, Simane, questioned the use of a Gaussian distribution, saying: "The number of stations which have an appreciable probability of single station registration is rather small -- about nine, ten or twelve stations. I therefore do not think it is very adequate to use the Gaussian distribution at this stage. You get a number rather smaller than the real case."¹¹²

Brown of the United States noted that "the geometry ...does enter in much more deeply as you go to a relatively wide-spaced net, which we now have.... In some of the cases...the average number of stations detecting is more than five; it may be six or seven." But he suggested there was a variance: stations in the second zone sometimes would detect, sometimes would not detect first motion. Brown argued that, although in some cases the average number of stations detecting would be large, it could be smaller or larger, depending on conditions. This led him to believe that, using the central limit theorem, even with ten relatively independent events, "the probability distribution would be a close approximation to a Gaussian distribution -- certainly close enough for our purposes."¹¹³

Eleven days earlier, another Simane-Brown exchange had taken this tack:

SIMANE: Dr. Brown obtained a number equal to zero of registration and identification of underground tests. However, there exist two other probabilities,

¹¹²Ibid., p. 61.

¹¹³Ibid.

namely, that the explosion will be registered and not identified, and that it will not be registered nor [sic] identified. I would like to point out that the last probability cannot be equal to one.... The violator will be interested in the probability of the explosion not being detected, and this cannot be equal to the certainty. I think that from the standpoint of the possible violator, even very small probability of detection and identification will prevent him from violating the agreement on...nuclear tests.

BROWN: My analysis...was only an analysis of the probability of being able to ascertain that an earthquake was an earthquake. I did not attempt to include...an answer to the question what is the probability of detection of a nuclear explosion?... You are correct...the probability of detection is fairly large for such an event.... However, the exact numbers are a matter of opinion both as regards what it is, and what is necessary to deter, except for the fact that detection does not deter anybody. What deters someone is identification, and the problem of identification of a nuclear explosion is inextricably bound up with the problem of identification of natural events. If there is an enormous number of natural events...then the problem of picking out the explosion, the violation, from all of these uncertain events becomes an extremely

difficult thing to do; in fact, it is a well
nigh impossible thing to do.¹¹⁴ [Emphasis
supplied.]

These excerpts are part of an extensive debate on the capability of the control network, what mixtures of stations would be called for, and the probability of detecting a one-kiloton explosion under a variety of circumstances. Even within the bounds of what was ostensibly a statistical inquiry, as the passages emphasized above suggest, the participants seem to have been aware of the political implications of even the most technical-sounding calculations. The issue of what kind of a system will deter violation, mentioned obliquely by both Simane and Brown, is clearly a political and psychological one. Yet the statistical arguments of both sides were apparently influenced by half-explicit considerations of this kind. Whenever the possibility of wilful interference with the control system by its agents arose in the discussions, the judgments of the debaters became more openly political, and even personal.

The Russians supported their arguments for not asking too much of the initial verification system by contending that the progress of technology would eventually put more refined tools of inspection in the hands of the contemplated control organization:

A large number of people will be employed by this control service. Those people will be scientists, engineers, experts, and many of

¹¹⁴Verbatims, July 31, pp. 86, 87.

them will be young and in one, two or three years they will invent so many things that the lives of the violators will not be worth living.¹¹⁵

In Federov's view, very little was required to deter violations anyway. A limited number of on-site inspections should be allowed, but "in this connection we should again bear in mind that the obligation of Governments not to conduct nuclear weapons tests will have such tremendous moral significance and will attract so much attention from other governments that no one assuming such an obligation will dare violate it."¹¹⁶ While the Russians gave grudging acceptance to the principle of on-site inspection at the technical talks of 1958, they had it on their veto list by the time political negotiations began. Subsequently, the Soviet Union took the position that provided a sufficiently small quota of inspections could be agreed upon it would not insist that member nations of the control commission possess the right of veto.¹¹⁷

To alleviate Western concern, the head of the Communist delegation said: "Governments which will participate in the control system, which will have recognized the need for inspection in a number of instances for the purpose of

¹¹⁵ Ibid., July 28, pp. 68-70.

¹¹⁶ Ibid., July 30, p. 31. For an analysis of this aspect of deterring violations see Fred C. Iklé, "After Detection -- What?" Foreign Affairs, January 1961.

¹¹⁷ U.S. Senate, Subcommittee on Disarmament of the Committee on Foreign Relations, Hearings on Technical Problems and the Geneva Test Ban Negotiations, 86th Cong., 2d Sess., p. 31.

verifying suspicions,...are unlikely then to put obstacles in the way of inspection when it is operating."¹¹⁸ Although theoretically it was possible that the personnel of control posts might attempt to deceive, the signatories to a treaty should, in Federov's words, have "faith and not place a second set of controllers (i.e., representing the adversary) in the...post. We must also have faith in the crew members of the aircraft that will collect sampling from the air.... We must...have faith in the information provided by meteorological stations.... I am not going to repeat...the whole series of arguments in support of the fact that the observations from a number of seismic stations are extremely hard to distort. This will be quite a problem for any violator and, as far as I can see, an impossible one to overcome."¹¹⁹ Fisk, United States, retorted that it was most important to have an assurance on the availability and reliability of the data. He did not favor, nor did he believe Federov would accept, a system based on "faith, hope and charity."¹²⁰

The Western delegation stressed that conclusions without "intelligent" interpretation did not constitute a sufficient basis for an appraisal of control capabilities. "There must be...considerations of probabilities, what mixtures of stations...and things of that kind,...."¹²¹

¹¹⁸Verbatims, August 12, pp. 72, 73-75.

¹¹⁹Ibid., August 5, p. 76.

¹²⁰Ibid., p. 77.

¹²¹Verbatims, August 1, pp. 72-75.

When discussing the electromagnetic method of detection, Western delegates pointed out the courses of action a violator might take that would greatly reduce the signal strength from a nuclear explosion. This, they said, applied "in our experience not only to the shielded shot described [in the conference] but [also] to one other shielded shot under different circumstances...."¹²² When discussing underground events, the West concluded: "Although an underground nuclear test carefully planned and executed could probably be conducted in such a manner that there would be a low probability of subsequently locating it with sufficient accuracy to allow identification by the means suggested, it should be pointed out that no amount of such care in planning could give complete assurance of escaping detection by the means of inspection [proposed by the Western experts]."¹²³

Divergent views on the accuracy of various methods of detection, on the capability to identify an event as natural or man-made, and on the correspondence between theory and data marked the discussions on probability of violations.¹²⁴ This is not surprising for, in addition to the asymmetry between the political goals of the two sides, a gap existed between theory and experimental results in a number of important areas -- among them those dealing with seismic methods of detection and identification.

¹²²Ibid., August 11, p. 81.

¹²³Ibid., July 28, p. 51.

¹²⁴See for example the verbatims of the plenary sessions of July 8; pp. 38-40, 41, 42, 47; July 14, pp. 77-80; July 16, pp. 21-26, 31, 36.

The installation of arrays of 10 seismographs at each control post was considered and recommended at the 1958 conference. Later experiments confirmed the effectiveness of this method. Long-period surface waves were discussed by Technical Working Group II during November and December 1959. Other methods, though theoretically valid, could not be recommended because of insufficient experimental backing. They remained of potential interest, but awaited more experience and additional research.¹²⁵

It has been stated that within contemporary scientific capabilities, if no limitation had been put on the number of places where equipment could be installed to detect explosions, it would have been technically possible to provide a thoroughly efficient control system.¹²⁶ The more stringent the technical provisions for control, the greater the deterrent effect that may be exerted on a potential violator. The probability of violations, however, depends not merely on technical achievement, but also on political motives and intentions.

¹²⁵ These methods were: the use of the ratio of the amplitudes of horizontal and vertical waves, which might be more effective in revealing the characteristics of the source of the event; comparison of the shapes of entire longitudinal wave trains received at different stations, which might extend the capability of direct assessment of first motion. Conference on the Discontinuance of Nuclear Weapon Tests, Report of Technical Working Group II, December 18, 1959.

¹²⁶ Dr. John W. Tukey in U.S. Senate, Subcommittee on Disarmament of the Committee on Foreign Relations, Hearings, p. 43.

These illustrations of the East-West technical debate of 1958 disclose that the primary Communist objective was to prove monitoring a nuclear test ban feasible and not overly difficult. They also show how Western scientists indefatigably brought out the complexity of verification requirements and the need for their stringent enforcement. This basic difference between the two sides is manifest throughout the record of the conference.¹²⁷ In view of the strong influence that political considerations had on the development of the expert discussion it is all the more interesting to investigate how the conference was brought to a technical consensus.

¹²⁷ For the East, see Verbatims, Plenary Sessions of July 4, pp. 23-25, 27-30, 34, 66; July 5, pp. 41, 47; July 8, pp. 38-40, 47, 96; July 14, pp. 57-60, 66-76; July 21, p. 97; July 28, pp. 65-66; August 1, p. 21; and August 5, pp. 26 ff.

For the West, see Verbatims, Plenary Sessions of July 5, pp. 6, 7-10, 31-45; July 8, pp. 36, 48-50, 75-76; July 10, pp. 52, 71-76; July 14, pp. 22-25; July 18, pp. 6-10; July 21, pp. 82-85, 90, 101; August 4, pp. 22 ff; and August 11, p. 22.

V. SCIENTIFIC DISCUSSION AS DIPLOMATIC NEGOTIATION:
ACHIEVING THE REPORT

The Conference of Experts reported that it was technically feasible to establish an effective control system to monitor an agreement on the worldwide suspension of nuclear weapon tests.¹²⁸ This conclusion was agreed, after thirty plenary sessions and several informal meetings, through two conceptually distinct but operationally interwoven procedures: scientific discussion and political bargaining.

The objectives of scientific inquiry and of political negotiation are fundamentally different. The desire for explanations at once "systematic and controllable by factual evidence...generates science; and it is the organization and classification of knowledge on the basis of explanatory principles that is the distinctive goal of the sciences."¹²⁹ In scientific investigation, the quest for explanations is directed to relations between things irrespective of their bearing upon human values.¹³⁰ Science is not concerned with questions of national

¹²⁸Report of the Conference of Experts, (EXP/NUC/28)
August 20, 1958.

¹²⁹Ernest Nagel, The Structure of Science, Harcourt, Brace Inc., New York, 1961, p. 4.

¹³⁰It should not be inferred that the practice of scientific method eliminates every form of personal bias. Ibid., p. 10.

interest or political ideology.¹³¹ Hence these questions are seldom discussed at international scientific meetings.

Diplomatic negotiation, on the other hand, is essential in formulating and executing foreign policy and therefore helps to safeguard national interests, and to promote political ideology. In diplomatic negotiation much depends on the total political context, domestic and foreign, within which the negotiator operates. Although "clear knowledge on the part of the negotiators of their own objectives and realistic assumptions concerning the aspirations and aims of others form a solid basis for negotiation and settlement,...the individual approach of negotiators is influenced by...factors such as their social and educational background, power position on the domestic political scene, political philosophy and ethics, as well as national traditions, government system, particular views of...the role of diplomacy,...the nature of specific foreign policy objectives and issues."¹³²

Values importantly affect negotiation. The radical difference between the operational codes of Soviet and Western negotiators often leads to a nearly complete breakdown in communication between them.¹³³ In scientific

¹³¹This characterization does not necessarily apply to technology that serves national ends and may exhibit "national" traits.

¹³²Stephen D. Kertesz and M. A. Fitzsimons (eds.), Diplomacy in a Changing World, University of Notre Dame Press, 1959, pp. 133, 134.

¹³³For an extended treatment of this problem see N. Leites, Styles in Negotiation: East and West on Arms Control, 1958-1961, The RAND Corporation, RM-2838-ARPA, November 1961.

discourse, on the other hand, communication between individuals is unhampered by nationality, social tradition, or political affiliation. A scientific consensus, therefore, is normally reached by a process essentially different from that required to achieve political accommodation.

The experience of joint East-West expert discussions at various technical conferences connected with a nuclear test ban suggests that politics will intrude even where the subject of discussion is seemingly technical.

A. THE MECHANISM OF AGREEMENT

By the third plenary session, the experts had agreed on a procedure for joint study of each of the methods of verification -- acoustic, seismic, and so on. Each side would present statements about its understanding of the applicability of the method under discussion and of its capability to detect and identify "events" through prescribed techniques and instruments. Cross questioning would follow each side's presentation. An attempt would then be made to agree on draft conclusions for each set of techniques. Finally, after the various methods had been investigated, the two sides would consider how the different measuring devices should be linked together systematically to achieve the most effective verification. A communiqué was to be issued at the end of each working session.¹³⁴

¹³⁴Verbatims, July 4, p. 47, and July 7, p. 79.

This procedure, though logically consistent with the general aim of the conference, led to some difficulties. A formal injunction from the participating governments required that the talks reach conclusions as quickly as possible. Hence a tendency arose to allow some questions to remain unresolved, either by procrastination or by a swift agreement in principle that almost precluded controversy over details. The latter expedient may account in part for the relative lack of qualifications in the Report concerning the effectiveness of the verification system proposed. The postponement of difficult points for later discussion contributed to a major concession on August 5, when the Western delegation stated its willingness to drop consideration of the 650-station network it had presented, and to negotiate conclusions on the assumption that the network would have 170 land posts and several meteorological ships. This meant scrapping the original Western requirement that the control network have a ninety per cent probability of detecting an event of one kiloton energy yield and substituting a requirement for a ninety per cent detection capability at five kilotons. It was suggested that the smaller system's capability might be improved, in the one to five kiloton range, if the control organization undertook some random inspections of unidentified events of less than five kilotons.¹³⁵ The final report recommended for consideration by the governments a network of control posts comprising 160 to 170 land-based posts and about 10 ships.

¹³⁵Verbatims, August 5, pp. 26-60.

A threat to withhold agreement may be used in negotiation as a means to force one's demands on the opponent.¹³⁶ This tactic will be all the more effective where a limited time has been allotted for a conference, as was true of the meeting of the experts. By early August, indeed, most of the agreed period had elapsed. A number of other factors also helped to create conditions favorable to a Western concession. Tacit acceptance by the West that adequate control was feasible in principle, if not in all technical circumstances, had not been shaken by the debate on methods, and the prevailing negotiatory character of the discussion lent weight to Soviet insistence that the presentations of each side be considered proposals. Hence, although the Western delegation believed that a number of systems variously capable of identifying earthquakes at one, five, or more kiloton equivalents were well within the scope of discussion, Soviet refusal to consider any but the 180-station system acted as a sanction and induced the Western concession.¹³⁷

The Western concession on the size of the control system was not only the most substantial one of the conference, but also the clearest example of how technically correct conclusions were set aside by the West, whose delegation evidently felt compelled to reach some

¹³⁶ Thomas C. Schelling, The Strategy of Conflict, Harvard University Press, 1960, p. 15.

¹³⁷ U. S. Congress, Joint Committee on Atomic Energy, Hearings, p. 19.

sort of agreement. Other compromises were less spectacular but significant in the aggregate. These were disguised in technical garb and, consequently, do not stand out so clearly in the record.

A main goal of the experts' discussion as we have seen, was to agree on measuring techniques adequate for a controlled test cessation. Many arguments arose over the procedures by which one side or the other had obtained the data it was using to establish or impugn the reliability of one or another method for detection and identification of explosions. Other differences of view appeared when the theory advanced by one side seemed incompatible with the experimental results presented by the other.¹³⁸ How, then, did the discussants reconcile divergences and reach agreed conclusions?

1. Agreement "in Principle"

Since the agenda required that the delegates reach conclusions on methods of verification before discussing systems of control, they were under pressure to reach agreement on each method in order to allow sufficient time for discussion of the over all problem. Conclusions, however, were not always readily forthcoming. The two delegations often failed to agree on some aspect or other

¹³⁸For illustrations of the two kinds of discord see the verbatims of the plenary sessions of July 7, pp. 56, 57, 63; July 8, pp. 52-55, 56, 67; July 9, pp. 11, 46; July 11, pp. 11, 61; July 14, pp. 41-86, 93-105, 111; July 15, pp. 14-15; July 16, pp. 31, 41; July 17, p. 17; July 18, pp. 47-50; July 21, p. 107; July 22, p. 6; July 30, pp. 72, 81; July 31, pp. 31, 88-90; August 1, p. 21; August 4, pp. 17, 31, 57; August 11, p. 11; and August 12, p. 21.

of the methods discussed. The negotiatory style of the talks added to the difficulty of reaching conclusions on some matters.

One technique for facilitating agreement was promoted by both sides, but in varying contexts. This was the elimination of details unacceptable to one side by agreeing to agree "in principle." Early in the conference, this procedure was justified on the ground that extended disputes over details would unnecessarily slow the proceedings. In any case, agreement on details might not be essential since, at a later stage, the effectiveness of all control methods and their related equipment would be considered together.¹³⁹ During the first stage of discussion, a rough evaluation of the methods would be appropriate; having examined all the methods and reached conclusions about them, the details could be examined later. It was also argued that to include specific detail in the draft conclusions on each method would prejudice the final judgment on the over-all system.¹⁴⁰

Agreement "in principle," whether expressed or implied, was a device used to overcome differences of view on particular technical questions. For example, when an impasse had been reached on whether ground-based or aircraft sampling would be the more effective measure for implementing the nuclear débris method of detection, the two sides resolved it by agreeing in principle.

¹³⁹Verbatims, July 7, pp. 71, 74, 75-77 and 78.

¹⁴⁰Ibid., July 10, p. 101.

Fedorov, looking for a compromise formula, argued as follows: "The point is that we agree that in principle it is possible [to collect adequate radioactive debris by ground stations], and we know how that could more or less be done.... I do not wish to pursue the matter very much further. I simply point out that you agree that in principle such a determination is possible -- is that not so?...Therefore...we might indicate that in principle this is possible...." To this Fisk responded, "Shall we use the same phraseology with respect to aircraft that 'in principle' it will be possible?"¹⁴¹ When, just over a week later, draft agreement on the nuclear debris method was reached, the Eastern delegation continued to believe that sampling by aircraft was not absolutely necessary, but it accepted a reference to this technique in the draft.¹⁴²

The question of agreement in principle arose also in a somewhat different context. When one side wanted to incorporate certain nuances in the preliminary draft conclusions, as additional arguments for its own point of view, it argued that they should be included since they had not been proved false in principle by the other side.¹⁴³ It should be noted, that regardless of the

¹⁴¹Ibid., July 12, pp. 51-55.

¹⁴²Ibid., July 21, p. 21. For other examples see the verbatim records for July 8, p. 102; July 9, pp. 21-25, 57, 76-80; July 11, pp. 81 ff; July 16, pp. 31 ff; July 22, p. 3; August 1, pp. 6 ff; August 4, p. 22.

¹⁴³Remarks by Leipunski during the session of July 23, pp. 13-15.

motive for advancing it, this kind of argument is not scientifically objectionable.

The political aspects of the technical discussions sometimes discouraged the arrival at a consensus through logical arguments and demonstrated facts. When this obtained, it fostered the tendency to reach conclusions through agreement in principle. Some of the short-cuts by which preliminary conclusions were achieved also affected the substance of the final conclusions on the system as a whole. Nevertheless, technical consensus was often achieved, and the gap between theory and experimental data in the subjects discussed made it often possible to disagree without violating the rules of scientific debate.¹⁴⁴

2. Semantic Adjustment as a Method of Reaching Conclusions

Once the discussions acquired many of the characteristics of a bargaining situation, negotiatory behavior became more pronounced. We have already noticed the tendency to agree in principle in order to smooth over divergent views on detail. In arriving at an agreed set of draft conclusions the two sides also adopted a technique of semantic adjustment of the text, by qualification, addition, or deletion. Such adjustments are common practice in the drafting of protocols, resolutions, or recommendations that embody the conclusions of international conferences. Though there is some confusion

¹⁴⁴See for example: Verbatims, July 9, pp. 21, 22-25; July 10, p. 61; July 16, pp. 47-50; July 22, pp. 17, 72; and July 31, pp. 56 ff.

about the precise legal force of these recommendations,¹⁴⁵ clarity of the textual language is valued, in international law, as a guide to the purpose of the document. On the other hand, it is questionable whether clearness of expression, achieved through adjustment of language, is necessarily indicative of the adequacy of conclusions reached by technical discussion.

Drafting the texts of the report and the conclusions on each detection method developed along two different lines. The delegations -- or more typically some of their members -- searched for a mutually satisfactory set of words whose meaning was clear and noncontroversial. Secondly, they sought a form of expression that would emphasize points of agreement. One side sometimes conceded emphasis on a point that was of concern only to the other side.

The constant quest for satisfactory terms did not affect the final substance of the report as much as did bargaining over the exclusion or inclusion of various points.¹⁴⁶

¹⁴⁵D. H. N. Johnson, "The Conclusions of International Conferences," The British Yearbook of International Law, 1959, pp. 1-33.

¹⁴⁶See also Verbatims, July 1, p. 47; July 9, pp. 61, 66, 78-80, 81; July 10, p. 97; July 12, pp. 7-10; July 22, p. 3; August 1, p. 6; August 11, p. 3; and August 12, p. 86. One possible exception to this observation has been pointed out by Gilpin in American Scientists, pp. 211-212. It concerns the replacement on July 23 of "open seas" by "oceans" in the draft conclusion that deals with sampling flights. Gilpin maintains that this exchange of terms might have meant that no regular aircraft flights to collect radioactive debris would have been possible near

One way of settling the latter question was to eliminate from the preliminary conclusions matters on which an impasse had been reached, presumably with the understanding that these would be taken up later during the drafting of the final report. Sometimes the deletion of one sentence from a draft conclusion effectively ended controversy over a disputed point, though of course it did not reconcile the different views on that point.

When drafting conclusions on the possibility of recording nuclear explosions at very high altitudes, divergent views arose as to the accuracy and reliability with which effects upon the ionosphere could be recorded. One sentence in the draft presented by the West about the possibility of recording explosions by observing disturbances in the ionosphere was particularly unacceptable to the East. The impasse was surmounted by deleting the sentence.¹⁴⁷ On other occasions, too, agreement or

the Soviet Union. It should be noted, however, that although the mandate for such flights might have been later challenged because of this exchange, the term "high" or "open seas" may be said to refer, in international law, to all those waters outside the exclusive control of any state or group of states, and it includes the ocean up to the limit of territorial waters (H. W. Briggs, The Law of Nations, 2d ed., pp. 328-329). Fedorov himself acknowledged this broader legal interpretation when the change was effected.

¹⁴⁷Verbatims, July 28, pp. 3-15. Many instances of this kind of accommodation also occurred at informal meetings. These conclusions did not lead to recommendations in the final report.

acquiescence was reached by bargaining on the language of a draft conclusion rather than by a candid avowal of the substantive uncertainty involved.¹⁴⁸

The effect of this was that few points on which any disagreement remained found their way into the draft conclusions. Some points, qualifications of which had survived the debate, were lost in the process of drafting the report. Thus the report created an optimism about detection "in marked contrast with the technical reality as seen by the American scientists themselves." It omitted the important qualification that the recommended control system had a threshold "below which it was relatively ineffective."¹⁴⁹

The conclusions reached at the conference were, on the basis of then available information, technically correct.¹⁵⁰ Not all decisions taken by the Western scientists, however, were justifiable on technical grounds. The important Western decision to raise the "threshold" of detection for underground events from one kiloton to five in order to reduce the required number of control posts, was a political not a technical decision.

¹⁴⁸ See, for example, Ibid., July 11, pp. 81-86; July 22, pp. 3, 7-10, 16; July 24, pp. 4 ff.

¹⁴⁹ Gilpin, American Scientists, pp. 208-209.

¹⁵⁰ Testimony of Fisk in U. S. Senate, Subcommittee on National Policy Machinery of the Committee on Government Operations, Hearings on Organizing for National Security, 86th Cong., 2d Sess., Part II, 1960, p. 310.

3. Bridging the Gap between Theory and Experiment

Despite the great precision with which theoretical concepts may be expressed, it is difficult to achieve a unique correspondence between theory and evidential data.¹⁵¹ This discrepancy between theoretical and experimental ideas, particularly noticeable in the newer fields of scientific investigation, played an important part in the Geneva technical talks. For example, there had been many investigations of earthquakes, especially large ones. There had also been many seismic investigations of underground TNT explosions. And, the U. S. Government had made seismic measurements on above-ground nuclear shots. Nevertheless, the only good piece of evidence for calibrating the verification system proposed by the 1958 Conference of Experts was the Rainier underground nuclear shot. This paucity of data caused the conference to reach conclusions on the seismic method of detection based on calculations subsequently proved incorrect by a factor of a third on detection and two-thirds on identification.¹⁵²

The gap between theory and data was also widened occasionally because some pertinent data were classified.¹⁵³ This particular handicap, not peculiar to the experts' conference, has complicated arms control negotiation

¹⁵¹ Nagel, The Structure of Science, p. 100.

¹⁵² U. S. Senate, Subcommittee on Disarmament of the Committee on Foreign Relations, Hearings, p. 15.

¹⁵³ This difficulty was mentioned by Northrup, U. S., during the meeting of July 5. Severe restrictions were imposed on information about yields of nuclear explosions by the Atomic Energy Act, p. 32.

in general.

Many times during the conference disagreement arose over the applicability of a theory that did not seem compatible in all respects with the data submitted by one side or the other. The following is a good illustration of the difficulty posed in the conference by the need to bridge the gap between theory and experiment.

During the discussion of the seismic method of detection, the question whether the dynamic characteristics of seismograms could be used to reveal unambiguously the nature of the wave source was carefully considered since it was of critical importance to the deliberations of the scientists. Pasechnik of the USSR had presented a paper on the remarkable theoretical work concerning this question by Soviet seismologists, particularly Dr. Keilis-Borok who is noted for his efforts to put theoretical seismology on a rigorous mathematical basis, and widely-known and respected in the West. The Western delegation, nevertheless, questioned the applicability of his work on the following grounds:

In order to make the mathematics of theoretical treatments in seismology tractable, the theorist must make such simplifying assumptions about the earth as to cast doubt on their applicability to the subject of this conference. Indeed, the biggest wave on some of the Rainier seismograms should have been theoretically absent in the dynamic methods of interpretation. Dr. Pasechnik recognized this himself when he said that the singlet source which represents the Rainier explosion may have been inclined rather than vertical due to heterogeneous conditions of the rock. Inclined singlets

produce seismograms with shear and surface waves characteristic of earthquakes.... This was verified experimentally [by] the work of Dr. Caloi in Italy.

I have a slide which will show you an earthquake in Italy which produced directions of first motion radially outward in all azimuths. This was a natural phenomenon which produced seismograms precisely of the type we would expect from an explosion.... The point is this. We would not be doing our job properly if we did not base a seismic detection system on what is experimentally realizable at this time....¹⁵⁴

Similar difficulty arose over the possibility of detection by geophysical methods, owing to the absence of data on the geophysical surveys conducted after the Rainier explosion.¹⁵⁵ Consequently discussion leaned toward the theoretical. Knowledge of high-altitude explosions was even more limited than that of underground explosions. Experimental data were lacking, and the conference had to rely entirely on theoretical calculations.¹⁵⁶ Many other instances could be cited

¹⁵⁴Press of the United States in Verbatims, July 18, pp. 6, 7-10.

¹⁵⁵Ibid., August 12, pp. 12 ff.

¹⁵⁶Ibid., July 22, p. 56.

to illustrate the discrepancy between theoretical understanding and recorded data at the conference.¹⁵⁷

Finally, the intractability of some of the questions discussed may have been increased by the relatively greater gap in some fields of science between Soviet theoretical and experimental work. Indeed, an eminent Russian scientist later acknowledged Soviet weakness on the experimental side in the physical and mathematical sciences.¹⁵⁸

Discussion advanced mutual understanding about the possibility of narrowing the distance between the degree of accuracy of the detection techniques being investigated and the theoretical uncertainties on which a number of

¹⁵⁷ See the verbatim record for the meetings of July 4, pp. 4, 6, 10, 41, 48; July 5, pp. 3, 6, 37-40; July 7, pp. 5-6, 16, 18-20, 57 ff; July 11, pp. 4-5, 81-86; July 12, pp. 21, 22-25; July 14, p. 106; July 15, pp. 57-60; July 17, pp. 22, 23-25, 26, 57; July 18, pp. 6, 7-10, 32-57; July 22, pp. 23, 56; and August 5, p. 3.

¹⁵⁸ P. Kapitsa, "Theory, Experience, Practice," Ekonomicheskaya gazeta, March 26, 1962, p. 10, as reported in The Current Digest of the Soviet Press, Vol. XIV, No. 19, pp. 14-15. Kapitsa discusses this problem of Soviet science in frank terms, and exhorts young scientists to choose experimental in preference to theoretical work. It would seem that in all technical negotiations by far the largest part of the technical contributions have been made by the U. S. delegations, while Russian contributions have tended to be theoretical. (U. S. Senate, Subcommittee of the Committee on Foreign Relations, Hearing on Technical Problems and the Geneva Test Ban Negotiations., 86th Cong., 2nd Sess., p. 36.)

calculations rested. This helped to orient the conference's recommendations toward a verification system based on what was thought to be experimentally realizable. Even so, a gap between theoretical concepts and limited data cannot be reduced by logic alone. Theoretical discussion is not equivalent to experiments. Additional experience is usually needed. The experts solved this dilemma, caused by the constraints of imperfect knowledge, limited time, and divergent negotiatory goals, by introducing essentially two kinds of qualification in their final report. These represent an attempt to bridge the gap between theory and experiment, or to surmount the difficulty caused by the need to theorize from inadequate experimental data.

The first kind took note of the tentativeness of some of the conclusions. It indicated the insufficiency of knowledge on a given point that prevented a quantitative assessment. For example, when dealing with high-altitude detection, the report stated that "knowledge of the absorption of cosmic noise by ionospheric phenomena is insufficient to determine the number of natural events similar to those resulting from a nuclear explosion."¹⁵⁹ In other instances, the report stressed that conclusions had been reached by "a reasonable extrapolation of existing experience,"¹⁶⁰ or had been suggested by theoretical considerations.¹⁶¹

¹⁵⁹ Report of the Conference of Experts (EXP/NUC/28), August 20, 1958, p. 15.

¹⁶⁰ Ibid., p. 5.

¹⁶¹ Ibid., p. 13.

A second kind of qualification was added when the scientists noted that the range and accuracy of detection and identification could be improved in the future,¹⁶² and recommended that "improved apparatus and techniques should be actively developed and expeditiously incorporated into the control system for the purpose of continuously improving the effectiveness for the detection and identification of nuclear explosions."¹⁶³ The gap between theory and experience was to be closed by continued study and research.

After the Conference of Experts dispersed, additional information became available. It led to three more technical conferences concerning a test ban. One of them, held in May 1960, was specifically concerned with the coordination of research. The gap between theoretical and experimental knowledge was undoubtedly narrowed, but this only served to increase negotiatory difficulties by intensifying Soviet concern over political aspects of the technical points affected.¹⁶⁴

¹⁶²Ibid., pp. 6, 11.

¹⁶³Ibid., p. 19.

¹⁶⁴Experts from the United States, the United Kingdom, and the Soviet Union met at Geneva in June-July 1959 and drew up recommendations on high-altitude detection. Later that year, after very protracted and difficult negotiations, another technical conference convened to review criteria for on-site inspection of unidentified underground events, in the light of new data on underground nuclear explosions. Soviet scientists rejected U. S. calculations relative to decoupling, and new data regarding "first motion" technique. Especially during the final phase of the talks, they introduced strong political overtones into the scientific

B. THE ROLE OF THE INFORMAL MEETING

Differences of view were not always removed through formal technical presentation and discussion. Disagreement on vital points was often settled by means of technical discussion or accommodation outside the conference. When concurrence was not forthcoming at formal sessions, the informal meeting became the tool by which agreement was reached.

1. Purposes and Procedures

Informal or private meetings generally took two forms: consultation among specialists of the two sides, and discussion between the chiefs of delegation. Some meetings, though less informal, were still "off-the-record." Often the chief delegates would participate in a meeting of specialists.

Delegates from the two sides met informally in small groups throughout the period of the conference. They met to clarify technical calculations not understood in formal session, to probe for the limits of compromise on certain points, to draft or adjust the language of conclusions, and to agree on conclusions to be presented

discussion. In recent months, as a result of more nuclear experiments under Project Vela, the research program set up by the United States in 1960 to find improved ways of detecting underground nuclear explosions, more data were obtained which might make necessary another revision of the assessment of the problem of distinguishing earthquakes from small underground explosions. Improved seismic detection techniques have also been announced (New York Times, July 8, 1962).

for formal adoption in plenary session. For example, misunderstandings about how the West had reached a figure of 100 yearly events indistinguishable from one kiloton explosions, and about why it had concluded that 50 kilometers was the maximum altitude beyond which the propagation and registration of signals was impossible, were settled at private meetings.¹⁶⁵

Sometimes a series of informal meetings by specialists of the two sides to discuss a given method of detection led to adoption of a "tentative" draft conclusion, which was then reviewed by the heads of delegation in another private meeting, and finally either adopted officially or referred to a plenary session for additional discussion. It might even be sent again to an informal group.¹⁶⁶ Draft conclusions on the seismic method of detection were achieved in this fashion.¹⁶⁷ At other times, a smaller group met informally to adjust minor differences on drafts already submitted to the conference,¹⁶⁸ or to prepare conclusions for formal adoption.¹⁶⁹ Sometimes no informal agreement was obtained, but the groundwork laid by the smaller group made concord possible at the subsequent plenary session.¹⁷⁰ When mutually acceptable conclusions

¹⁶⁵Verbatims, July 9, pp. 26-30.

¹⁶⁶Ibid., August 1, pp. 3-5, 6.

¹⁶⁷Ibid., July 23, pp. 11, 66-67, and July 24, pp. 3, 12.

¹⁶⁸Ibid., July 23, p. 12, and July 25, p. 6.

¹⁶⁹Ibid., July 25, pp. 3, 4-5, 6; July 28, p. 16, and August 21, p. 3.

¹⁷⁰Ibid., July 28, pp. 3 ff.

were not reached by either expedient, they were sometimes settled informally by the chief delegates.¹⁷¹ Informal sessions were also sometimes used to probe for information, to determine the limits of compromise,¹⁷² or simply to draft the documents of the conference in their final form.¹⁷³

2. Achievements of Informal Talks

Most draft conclusions on the various methods of detection taken up by the conference were, in one phase or another of their development, the subject of informal talks between experts of both sides. The final version of the draft conclusions on the acoustic and electromagnetic methods; the compromise on the radioactive debris method that led to the adoption of the conclusions on that method on July 23; the conclusions on the equipment to be installed at control posts; and agreement not to include a recommendation on high-altitude detection: all these were produced by informal discussion. They represent but a sample of the achievement of the private sessions. More significant was the role played by informal negotiation in attaining the report of the conference.

¹⁷¹Ibid., July 23, pp. 12-16, and August 1, p. 7.

¹⁷²U. S. Senate, Subcommittee on Disarmament of the Committee on Foreign Relations, Hearings on Disarmament and Foreign Policy, Part I, pp. 13, 22-23.

¹⁷³Verbatims, August 19, p. 5.

Between August 5 and 11 three informal meetings took place, at which draft conclusions on verification systems were exchanged, and various substantive and drafting points discussed. Following the third meeting, it was decided to reconvene in formal session to hear analyses of the capabilities of the systems proposed.¹⁷⁴ Long private discussions led to understandings between the two sides on two crucial matters: the number and distribution of control posts, and the question of the criteria for inspection.¹⁷⁵ Once the respective positions on these questions had been made clear, and basic agreement reached, the conference was again adjourned to allow committee work on the drafting of preliminary conclusions on the control network.¹⁷⁶

On the foundation of agreement on the control network, itself based on agreed conclusions concerning the various methods of detection, the final report was erected. This was also substantially discussed and drafted in private meetings.¹⁷⁷ The report was adopted officially at the last plenary session on August 21, 1958.¹⁷⁸

¹⁷⁴Ibid., August 11, p. 3.

¹⁷⁵Ibid., August 12, pp. 82-85.

¹⁷⁶Ibid., August 12, p. 91.

¹⁷⁷Ibid., August 19, pp. 4, 5.

¹⁷⁸Ibid., August 21, pp. 3 ff.

The variety of tasks performed at informal meetings and the frequency with which such meetings occurred illustrate the importance of committee discussions at the Experts' Conference. Informal meetings constituted an additional forum for technical consultation and for negotiation. The nature of the subjects discussed and agreed upon gave these meetings a decisive role.

To stress the importance of the informal meetings is to indicate the basically negotiatory nature of the Geneva technical conference. Though the resolution of divergent views and the drafting of reports are tasks often delegated to committees, even at technical conferences, the bargaining that occurred outside the plenary sessions is not generally a feature of international scientific meetings. The issuance of a communiqué to the press after each plenary session and the formal recording of the proceedings inhibited frankly negotiatory exchanges in the larger body, since the avowed purpose of the conference was technical. A freer exchange of views and genuine bargaining could and did occur at the private meetings. Consequently, the crucial negotiations leading to agreement took place outside the plenary sessions. The efficacy of private and informal negotiation is well understood in connection with political activities. That it would be similarly effective at a conference ostensibly devoted to the establishment of scientific criteria was an open question before the Experts' Conference.

Despite the attacks on traditional "closed" or "secret" diplomacy since Versailles, private and informal negotiation has continued to facilitate international agreement. The increased frequency of diplomatic

conferences and their exploitation by Soviet propaganda have made private consultations all the more essential.¹⁷⁹ The experience of the 1958 Experts' Conference provides evidence that the principle applies to technical as well as political conferences.

¹⁷⁹ The usefulness of private negotiation is widely acknowledged by diplomatists and has been confirmed by practice. Secretary of State Rusk, in his address to the National Press Club in Washington on July 10, 1961, in stressing the right of citizens to know how the nation's policies were being conducted, cautioned against too much public diplomacy. He said that differences between the United States and its allies "are more likely to be resolved by quiet conversation than by public quarrel," and that, though our policies are and should be public, our "diplomacy cannot always be so, or else it would be little more than debate, adding its fuel to the very fires it hopes to quench."

Private negotiation was instrumental in settling the Berlin blockade in 1949, the Burma-China border dispute in October 1961, French-German foreign policy differences under de Gaulle and Adenauer, divergences between Finland and the Soviet Union in November 1961, the Trieste problem in 1954, and recently, in June 1962, the U.S.-Mexican dispute over the waters of the Colorado River.

VI. CONCLUSIONS

One salient characteristic of the emergent diplomacy of the nuclear age is its increasing dependence on the advice of technical and scientific experts. The enlarged technical scope of political negotiation has increased the need for expert participation at conferences and also for technical judgment in the formulation of negotiatory policy by governments. This dependence on technical and scientific advice has generally characterized arms control negotiation and is well illustrated by the negotiations for an agreement on the cessation of nuclear weapon tests.

The offer of technical advice to diplomats, especially by the military, is not new; what is novel in today's diplomacy is the appearance of the technical expert in the role of negotiator. The scientist has become a negotiator, not as a result of deliberate policy, but through several factors that have markedly influenced the conduct of disarmament and arms-control exchanges. The primary influences on arms-control negotiation have been: the nature of modern weapons; the attendant high technical content of negotiation; and the difficulty of separating the political and technical aspects of arms control. The difficulty of separating technical from political considerations has been rendered practically insurmountable by the lack of common understanding about the purpose of joint technical meetings that has prevailed in East-West expert discussions. The politicizing of the technical-scientific discussion of arms control has ineluctably forced the technical or scientific expert into the role of negotiator.

Although the Experts' Conference of 1958 was not the most politicized of the arms-control technical talks, it demonstrates clearly a characteristic interplay of political and technical factors and the incompatibility of Communist and Western approaches to technical discussion. The Western delegation understood the purpose of discussion to be a scientific investigation of the capabilities of technology to furnish effective means for monitoring a nuclear test ban. The Russians and their colleagues treated the talks as a positive step toward the cessation of nuclear tests by either moratorium or agreement. The technical substance of the discussion was of secondary importance.

One important consequence of the Communist approach was that, in 1958, the experts reached agreement primarily through political negotiation notwithstanding the essentially technical content of debate. Arguments in technical and scientific garb predominated in both the plenary and the informal sessions, but their acceptance was often qualified by whether their application to various aspects of verification was deemed politically acceptable. The original intention of the Western scientists to keep discussion politically neutral was early modified by the negotiatory situation, which tended to put a premium on reaching agreement. Moreover, given the subject of the conference and the nature of Soviet negotiatory goals, a separation of the technical and political factors could hardly have been achieved.

A technical consensus in a negotiatory forum depends as crucially as a political consensus on the attitudes and assumptions brought to the conference by the expert representatives of the negotiating parties. The attitudes of one

side may harden or soften as the goals of the other side become evident and as the scope of discussion is fixed in an agenda. In technical conferences on arms control between representatives of the Communist and the Western powers, political bargaining and scientific argumentation are apparently not separable -- except for analytical purposes -- but form part of a single over-all process. Divergent technical views seem reconcilable, in the final analysis, only by political accommodation, though mutually acceptable conclusions may be drawn up in technical format. Moreover, reconciling what is theoretically valid with what can be implemented in practice may also raise negotiatory difficulties. These are bound to be aggravated by the divergent political goals of the participating governments and by their assessment of the political consequences of accepting a given set of technical requirements for verifying compliance.

At Geneva, the problem created by the presumed political consequences of technical requirements for compliance was well illustrated by the differing approaches of the two sides to the question of violations. Divergent political attitudes toward the possibility of violations influenced the assessment of the very capability of the verification system. This led to a situation, for example, in which it was difficult to reconcile the Soviet and Western draft conclusions concerning the effectiveness of the proposed detection system. The Soviet side evaluated the system by its ability to record events, while the Western experts considered the effectiveness of the system as a whole, including its capability to identify as well as to detect. No technical agreement as to the probability of evasion could close the gap that divided

the adversaries concerning the political acceptability of control systems -- even those that both sides admitted to be technically feasible, and to a degree effective.

The Experts' Conference also made explicit the inherent difficulty of agreeing, in the process of technical debate, on the acceptable limits of risk flowing from various detection capabilities. Though experimental information was lacking, the main problem was not agreeing on the technical facts, but using them as a basis for political decisions that were outside the conference's terms of reference but had to be made if the conference was to achieve its purpose. For example, the determination from the viewpoint of national security of the adequacy of a verification system that is admitted to have a given degree of technical reliability is ultimately a political not a technical question.

If the 1958 experts' talks are seen in relation to the negotiations on the test issue in the 1957 London disarmament conference, to the preceding unilateral test suspension by the Soviet Union, and to that country's proclaimed aim to force British and American test cessation, the optimistic approach of the Communist experts to the difficulty of verification is readily understood. Their behavior was a direct reflection of Moscow's political guidance. By contrast, the failure of the United States Government to arrive at certain necessary policy decisions before the conference seriously hampered the Western delegation.

Not only did Western scientists have inadequate data, but still worse, the political basis of their efforts was vaguely defined. Particularly uncertain were the political criteria for assessing the adequacy of verification procedures.

The basically negotiatory nature of the conference, coupled with inadequate political guidance, put the West at a disadvantage. The American scientists were forced to negotiate on questions they had not anticipated, and on some points to formulate policy ad hoc.

The exact changes in the American position are difficult to determine from the available record. Nevertheless, had the U.S. policy-makers fully understood how intimate is the relationship of political and technical factors in joint technical discussions between representatives of rival states, and how difficult it is to exclude the negotiatory process from such talks, they might have given more extensive guidance to the Western experts. Had they done so, the Western scientists would doubtless have been more conscious of their role as negotiators. If, in addition, the technical aspects of verification systems had been thoroughly studied in advance, and if a consensus had been obtained among the American experts concerning the risks involved in accepting various levels of verification capability, then the Experts' Conference might have bequeathed to the subsequent U.S. position at Geneva a more solid base for the defense of on-site inspection. In a word, the politically acceptable parameters for several hypothetical systems of verification should have been defined for the Western experts before the conference met.

The conclusions reached here from the Western experience at the 1958 technical conference are borne out by events at later technical as well as political talks looking to a nuclear test ban, and by the Geneva Surprise Attack Conference. In considering negotiatory policy, it is

unrealistic to expect that political and technical questions can be kept separate. It is therefore probably unwise to hope, as some have hoped in the past, that joint technical discussions can be used to smooth the way to political agreement.

The 1958 Experts' Conference has shown how consultations between political opponents intended to be purely technical can become politicized to a point where progress depends on negotiatory compromise, thus making a purely technical consensus impossible to achieve. If experts are forced to negotiate in presenting their technical findings, then progress toward arms control may be more rapid if technical agreement is achieved through a frankly negotiatory approach and candid bargaining on the basis of clearly defined positions. Perhaps, conversely, technical and scientific factors should be discussed freely by diplomats in political negotiations, with continuous advice from technical experts of equal rank who are present at the negotiations.

The method by which the final report of the Experts' Conference was achieved -- the delegation of circumscribed problems to select committees -- also supports the idea that a deliberately negotiatory approach would be useful in technical as it obviously is in political talks. It may be objected that outright formal bargaining is not conducive to independent thought on the part of experts, and that it would vitiate the scientific content of a technical consensus. Yet we can hardly avoid the admission that postwar technical conferences on arms control between the Communist and Western powers have not been purely

scientific meetings. The comparison of data has not always led to similar conclusions by the scientists of the two sides. The presentation of available facts in a technical forum has led to conclusions influenced by political imperatives. Since decisions taken in political negotiations must be based on policy considerations much broader than purely scientific ones, it might help to integrate the technical and political aspects, and to consider the quest for formal arms control agreements as an essentially political or negotiatory activity.

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